



QUESTION TIME
IS YOUR AVIATION
KNOWLEDGE SET
FOR A THUMBS UP?
FESTIVE QUIZ P34

WRONG TURN
Intersection departure
led to Qatar 777 colliding
with approach lights in
Miami misadventure **15**

TRAINING LIFT
Australia to transform
military instruction, with
deal signed for new fleet
of PC-21 turboprops **17**

FLIGHT

INTERNATIONAL

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15 DECEMBER 2015-4 JANUARY 2016

ROLL-OUT

MAXIMUM AMBITION

Boeing targets Toulouse's narrowbody
lead as re-engined 737 Max emerges



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COVER IMAGE

Jeremy Dwyer-Lindgren captured this shot of the *Spirit of Renton* – the first test example of the 737 Max, emerging in Renton on 9 December **P10**



BEHIND THE HEADLINES

Stephen Trimble secured an invitation to Boeing's *Renton* site in Washington, where he witnessed the low-key roll-out of the 737 Max 8 (**P7, 10**). The CFM International Leap-1B-powered *Spirit of Renton* should get airborne for the first time during 2016



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IMAGE OF THE WEEK

A Boeing C-17 from the Royal Australian Air Force's 36 Sqn paid a recent visit to the Wilkins Aerodrome in East Antarctica. The strategic transport delivered supplies including a Haggglunds all-terrain vehicle over a distance of 1,860nm (3,450km). The service operates eight of the type

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Commonwealth of Australia

THE WEEK IN NUMBERS

↓ **2.3%**

Woodford fund management

Having lost confidence in Rolls-Royce's civil aero engines business, long-time investor Woodford has sold its stake

↓ **€350m**

Airbus Defence & Space

Value of Airbus Defence & Space's contract to deliver ESA's "JUICE" Jupiter mission spacecraft, for launch in 2022

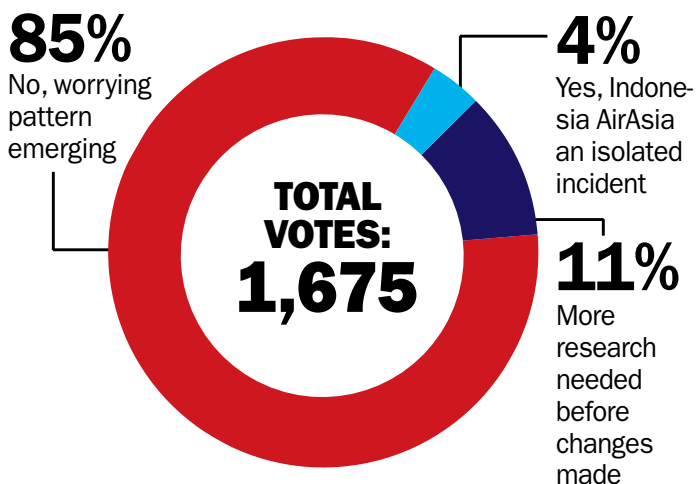
↓ **1,100**

Flightglobal.com

Number of helicopters grounded by the US Army during a five-day "safety stand-down" following rash of fatal crashes

QUESTION OF THE WEEK

Last week, we asked: **Are airline pilots adequately trained to deal with high-altitude emergencies?** You said:



This week, we ask: **How will the 737 Max perform against rival A320neo?**

- ☐ Airbus will maintain sales lead
☐ Expect a 50:50 split ☐ Boeing to win in the long run
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Déjà vu all over again?

Another new 737 rolled out of the factory in Renton on 9 December. But this time around Boeing should not assume narrowbody market dominance – or even parity, it appears

A long-time resident of Renton, Washington, could be forgiven for feeling a bit of déjà vu on 9 December when, for the fourth time in five decades, Boeing rolled out a new version of its venerable single-aisle airliner. Each successive model has featured more efficient engines and other updates, but has otherwise borne an unmistakable likeness to the 737-100 that first emerged from Boeing's factory on Lake Washington 49 years ago.

As familiar as the aircraft may be to neighbours, however, the first 737 Max 8 to see daylight – although dampened by Seattle's December murk – will enter a marketplace that would be unrecognisable to any of its predecessors.

At the end of 2015, one manufacturer clearly dominates the lucrative single-aisle segment – and it is not based in Renton. Airbus commands the market for the next generation of re-engined narrowbodies, with 60%

It is difficult to imagine how the market might reach the 50/50 balance Boeing expects

of the market – a lead that is probably insurmountable. More than 7,300 firm orders for A320neo and 737 Max aircraft combined have been signed to date. According to Boeing's 20-year market outlook, that overall backlog total represents more than one-quarter of all single-aisle deliveries expected through 2034.

Boeing executives maintain that they are still playing catch-up, since Airbus had a roughly nine-month lead before the launch of the 737 Max in August 2011 provided a sales challenge to the A320neo. Or perhaps Boeing is feeling déjà vu as well. If the comparatively-



Have we met before?

modest order backlogs of the late-1990s still prevailed, the company might have a case. But the huge number of orders already in hand make it clear that the A320neo's lead over the 737 Max is neither a statistical fluke nor the result of a nine-month headstart for Airbus on the airline marketing circuit.

Basic market forces are likely to erode Airbus's 20-point advantage eventually, but it is difficult to imagine a scenario that would cause a shift toward Boeing's stated goal of a 50/50 balance.

If parity is unachievable in the narrowbody sector, Boeing still has a chance to grasp a lead on Airbus in the more lucrative – and less competitive – widebody segment. It also has an opportunity to open up a new market that is sized between standard definitions of narrowbody and widebody.

Still, the future for Renton is not bleak. If the A320neo did not exist, the nearly 3,000-aircraft backlog that Boeing racked up before it rolled out the 737 Max would have shattered all previous records. ■

See This Week P7, News Focus P10

Fond of Honda

After a lengthy 13-year development effort, Honda Aircraft's HondaJet finally crossed the finishing line on 9 December, when the US Federal Aviation Administration awarded full approval for the light business jet.

This is a major achievement, not least because Honda has become one of only a tiny number of independent ventures to have broken into a segment dominated by Bombardier, Cessna and Embraer.

What sets Honda Aircraft apart from the plethora of doomed start-ups that have gone before it? The answer is the deep pockets of its owner, Honda Motor Company. The Japanese industrial giant is believed to have so far spent around \$1.5 billion on its first aircraft programme.

Investment aside, the \$4.5 million HondaJet appears

impressive. Its unique over-the-wing engines and class-leading cabin have already helped to pull in over 100 orders. It could well provide an industry shake-up.

Of course, we have been here countless times before. Impressive performance is no guarantee of long-term success. The HondaJet is pitched at a section of the market prone to sharp downturns in response to economic turmoil, and the global financial picture is looking challenging at best.

Credentials in other industries do not necessarily translate to aviation either. But incumbents should not rest on their laurels – just ask the US automotive industry what happened when the Japanese arrived. ■

See This Week P7



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BRIEFING

LUFTHANSA TO TAKE NEO LEAD ROLE

ACCEPTANCE German flag-carrier Lufthansa appears set to move ahead of Qatar Airways and become the first to receive the Airbus A320neo. The airline on 10 December confirmed that it has agreed to be “launching customer”, and was preparing for a delivery before year-end. Speaking in New York the previous day, Qatar Airways chief Akbar Al Baker had stated that any delivery delay would be due to PW1100G engine supplier Pratt & Whitney. Referring to its customers, Airbus says: “It is their privilege to announce delivery dates.”

EASA GREEN LIGHT FOR HIGHER-DENSITY ATR -600

TURBOPROP ATR has secured European Aviation Safety Agency approval for a higher-density interior for its ATR 72-600 turboprop, enabling it to offer an increased capacity of 78 seats – four more than the previous limit. ATR, which has carried out adjustments to the type’s forward cargo bay and seat pitch, says the new option will also be available as a retrofit package. The first 78-seat aircraft will enter service in August 2016. Cebu Pacific was the first airline to select the configuration, when it agreed to take 16 aircraft.

UK COMPLETES CHINOOK FLEET EXPANSION

ROTORCRAFT Boeing has delivered its final CH-47 Chinook to the UK Royal Air Force from a 14-unit, £1 billion (\$1.5 billion) deal signed in 2011. Acceptance of the HC6-standard transport helicopter takes the UK’s fleet of the tandem-rotor type to 60 aircraft.

MRJ BACK IN THE AIR AS TEST FLIGHTS CONTINUE

PROGRAMME Mitsubishi Aircraft had by early December performed two additional test flights with the initial MRJ prototype since its 11 November maiden sortie. The additional flights took place on 19 and 27 November, says the Japanese airframer. It has not disclosed the test points achieved, but says the aircraft’s landing gear and flaps – which were kept fixed during the first flight – were operated. First delivery is scheduled for the second quarter of 2017.

JET BLAST FROM TAXIING 747 DAMAGED BUSES

INCIDENT German investigators have revealed that two passenger buses were badly damaged by jet blast as a Lufthansa Boeing 747-8 taxied into a parking position at Frankfurt Main on 11 August. One passenger was injured when a number of windows were shattered on both vehicles. Investigating authority the BFU says that three of aircraft D-ABYJ’s General Electric GEnx-2B engines were generating thrust at the time, with both port-side engines running at higher than recommended power as it increased speed to 7kt (13 km/h).

ROTORCRAFT ASIA PICKS FG FOR KNOWLEDGE ROLE

SHOW Flightglobal, the publisher of *Flight International*, has been named as exclusive Knowledge Partner for the inaugural edition of Rotorcraft Asia, a helicopter trade show being launched by Singapore air show organiser Experia Events. Taking place on 18-20 April 2017 at the Changi Exhibition Centre, the biennial show will focus on the oil and gas, corporate, medevac and law enforcement sectors.
www.rotorcraft-asia.com

SUPER HORNET SHIFT FOR BLUE ANGELS

UPDATE The US Navy has announced plans to replace its Blue Angels demonstration team’s Boeing F/A-18A-D-model aircraft with a squadron of adapted F/A-18E Super Hornets. Its current Hornets replaced the Douglas A-4 Skyhawk in the role in 1986.



Crown Copyright

RAF surveillance type is derived from King Air 350CER platform

INTELLIGENCE BETH STEVENSON LONDON

Raytheon reveals UK Shadow plans

Contractor details path towards increased fleet size, after surprise announcement contained in recent defence review

Expanding the UK Royal Air Force’s Raytheon Systems Shadow R1 signals intelligence fleet from five to eight operational aircraft – as revealed by the nation’s government in November – will include the conversion of one example currently configured as a trainer, plus two new-builds.

The decision to boost the fleet from six, including a Gama Aviation-operated trainer, was announced as part of the government’s Strategic Defence and Security Review (SDSR). The additional aircraft are expected to be in service from 2019, with the fleet to operate until “at least 2030”.

While a contract covering the increase has not been signed, Raytheon says conversion of the trainer to an operational configuration is planned at its facility in Broughton, Wales. This is expected to be the first of the three Beechcraft King Air 350CER-derived aircraft available. The modification will include integration with a roll-on, roll-off mission system, potentially allowing that Shadow to be employed in a future training role.

Flightglobal’s Fleets Analyzer database shows the current aircraft are between five and eight years old.

The RAF’s Raytheon Sentinel R1 surveillance platform also was given a life-extension in the SDSR, which committed it to remaining in service “into the next decade”; the company says until 2021. Although one of the five-strong inventory is set for retirement by the end of 2016, Raytheon is confident this can be postponed.

A company source tells *Flight International* the UK’s acquisition of Boeing’s P-8 maritime patrol aircraft – including a Raytheon-developed radar – will not include an overland surveillance capability initially, meaning the Sentinel could possibly be required beyond 2021.

Raytheon hopes to secure export orders for the battlefield surveillance-ruled Sentinel, with India and South Korea understood to have shown interest in the Bombardier Global Express-derived system.

Separately, discussions are ongoing over the UK’s planned buy of nine 737-based P-8s.

“We anticipate the Boeing P-8A Poseidon maritime patrol aircraft will enter service in the UK in financial year 2019-2020,” says minister of state Earl Howe. “Exact dates are yet to be agreed between the [Ministry of Defence] and the US Department of Defense.” ■



Software bug
blacklists
Dreamliners
THIS WEEK P8

THIS WEEK

MANUFACTURING STEPHEN TRIMBLE SEATTLE

Boeing ponders 737 output

Reconfigured production line gives airframer options, but has no plans to match A320 rate

Boeing continues to study the potential for increasing 737 output beyond its plan for 52 per month from 2018, but it stresses that there are currently no plans to go above that limit.

Thanks to extensive reconfiguration of its Renton, Washington production facility – including the new “central line” on which the initial 737 Max flight-test aircraft was built – the airframer now has one-third more capacity at the site. This gives Boeing more flexibility to respond to Airbus’s decision to increase A320 output to 60 aircraft per month before 2020.

So far, Boeing officials have not given any indication they intend to match that rise, but executives point to “upward pressure” on 737 demand and negotiations are ongoing with the supply chain.

“We are studying all the time,” says Keith Leverkuhn, Boeing vice-president and general manager of the 737 programme. “Airbus made their announcement. We like where we’re at. [Boeing] is



Re-engined model will power increased demand

challenging the supply chain all the time going, ‘What if? How high can you go?’”

In a different way, “going higher” was exactly how Boeing found extra capacity in Renton’s densely packed facility. Whereas Airbus spreads final assembly across four production lines in Europe, China and the USA, Boeing concentrates 737 final assembly under one roof at the 4-81 and 4-82 hangar bays.

Each hangar has contained a single assembly line with a feeder line running alongside. To estab-

lish a third assembly line, Boeing consolidated both feeder lines into a single, three-level vertical structure called the systems integration tool inside the 4-82 hangar. On the top two floors of the facility, workers install wiring and electronic systems inside completed fuselages nestled into nine available positions.

The lowest floor holds the build-up stations for major sections, such as the stabilisers and nacelles. ■

See News Focus P10

PROPULSION
STEPHEN TRIMBLE
WASHINGTON DC

GE9X engine core powers into evaluation

GE Aviation has begun another round of module-level evaluations on the GE9X before bringing the initial full-scale engine to test in the first half of 2016.

A demonstration core for the powerplant, selected to equip the Boeing 777X family, has performed trials in GE Aviation’s altitude simulation chamber in Evandale, Ohio.

The altitude tests pushed the core’s major sections – an 11-stage high pressure compressor, a third-generation, twin-annular pre-mixing swirler, and a two-stage high-pressure turbine – beyond design speed limits and above a compressor pressure ratio of 27:1.

“This is a key step in the GE9X technology maturation programme,” says Bill Millhaem, general manager of the GE90/GE9X engine programmes for GE Aviation.

The next phase of trials on the demonstrator core will focus on optimising the aerodynamic shaping of the compressor blades and on monitoring the workings of the combustor, says the company.

Cincinnati-based GE Aviation was to spend \$1 billion in 2015 to keep the GE9X development programme on track to enter service on the 777-9 in 2020.

The 777X will utilise GE’s most advanced engine to date.

In addition to the new compressor and combustor, the high-pressure turbine will feature heat-resistant ceramic matrix composites in the Stage 1 and 2 nozzles and Stage 1 shrouds, as well as advanced cooling technology in the Stage 1 blades and a 132in (335cm)-diameter fan of 16 blades composed of a new, hybrid composite structure. Flight tests of the GE9X are scheduled to start on a Boeing 747 flying test-bed in 2017. ■

PROGRAMME

12-year wait for certification over as FAA clears HondaJet for deliveries

Honda Aircraft has received US Federal Aviation Administration approval for its HondaJet HA-420 light business aircraft, allowing the manufacturer to begin making deliveries within days.

Greensboro, North Carolina-based Honda Aircraft has been pursuing certification of the light jet for more than 12 years, with the original HA-420 prototype completing its first flight in 2003.

Testing prompted Honda to redesign and enlarge the engine. A partnership with GE Aviation – GE Honda Aero Engines – produced the HF120 turbofan.

“Achieving FAA type certification for the HondaJet is a monumental milestone for Honda,”

says Honda Aircraft chief executive Michimasa Fujino. He describes the development and testing of the clean-sheet aircraft as “an unprecedented challenge” for the company.

During the test campaign, the

HA-420 accumulated more than 3,000 flight hours.

Production is ramping up at its Greensboro site, with 25 aircraft on the final assembly line. Honda has amassed around 100 orders for the \$4.5 million twinjet. ■



The HA-420 light business jet made its first test flight in 2003

SAFETY STEPHEN TRIMBLE WASHINGTON DC

Software glitch behind 787's 'jumps'

Issue with the way aircraft transmits position data causes air traffic management agencies to consider sanctions

Most of the Boeing 787s delivered to date have a software defect that, in at least five identified aircraft, have erroneously reported their location in the sky to controllers.

The defect has prompted two air traffic management agencies to put the Dreamliner on a "blacklist" for certain operations.

Though denying the software defect creates a safety hazard, Boeing says a service bulletin with instructions for operators to correct the position reporting error will be released "imminently".

The modifications are expected to be rolled out across the fleet through 2016, but Boeing has no control over if or when an operator chooses to implement a voluntary service bulletin, it says. New 787s delivered from Boeing's assembly lines are already equipped with the software that corrects the original defect.

The issue came to light last December at an ICAO working group focused on automatic dependent surveillance-broadcast (ADS-B) transponders, the satellite-based navigation system expected to replace secondary radar after 2020.

ICAO has since chronicled the problem in a series of reports from February to late November 2015, which are posted online but have so far been unreported.

BLACKLIST

The 787 software problem drove Canada's air traffic control organisation Nav Canada in 2014 to "blacklist" all 71 787s that were then using the country's airspace. That means the Dreamliners are not allowed to use reduced separation procedures offered to other aircraft equipped with ADS-B.

Airservices Australia considered a similar limitation for the 787 fleet because of the same problem, but the consequences would have been more severe. Unlike Canada, Australia mandates that all aircraft above 29,000ft must have ADS-B transponders. A blacklisted aircraft



Dreamliners operating in Australian airspace could have been limited to flights below 29,000ft

"The software update will restore full ADS-B functionality and its more efficient separations"

BOEING

would be treated the same as one that is not equipped with ADS-B, forcing 787 operators such as Qantas subsidiary JetStar to remain below 29,000ft while in Australian airspace.

Ultimately, Airservices Australia decided to accept the "risk" of allowing 787s to operate in ADS-B-mandated airspace with standard separation distances, ICAO's reports show.

Airservices Australia also notified controllers about the existence of the software problem.

Finally, the agency blacklisted the 787 on surface management systems at three airports – Brisbane, Melbourne and Sydney.

But the airport restriction was only intended to raise awareness about the software issue, as other airport position monitoring systems can pinpoint the 787's location on the ground.

Nav Canada first detected a problem on 1 July 2014, when controllers noticed a 787 appearing to deviate up to 38nm (70km)

from its planned track. The controllers alerted the flightcrew by radio, but the pilots insisted their instruments showed they were still on course. Suddenly, however, the 787 "was observed jumping back to the flight plan route" on the controller's screens, according to ICAO documents.

Around four months later, Airservices Australia noticed a similar problem when a JetStar 787 appeared to deviate "significantly" off-track, then suddenly "jump" back to the planned route on a controller's screen, the ICAO documents report.

SHARED PROBLEM

Both agencies launched investigations before discovering they had witnessed the same problem while attending a December 2014 meeting of the ICAO ADS-B working group. They would later learn an identical issue had been recorded in other airspace jurisdictions, including in Singapore.

At that point, Boeing was contacted to join the investigation. The company eventually traced the root cause back to the 787's packet-based data transfer system, which was passing the aircraft's position information from the integrated surveillance system to the ADS-B transponder, according to ICAO documents.

In rare cases, after passing a

planned turn upon crossing a waypoint, the data packets that arrived at the transponder would contain either the aircraft's latitude or longitude, not both. In those cases, the ADS-B transponder's software would extrapolate the 787's position based on the previous flight track before it made a planned turn at a waypoint. It would continue reporting the aircraft erroneously on the incorrect track until it received a data packet containing both latitude and longitude.

"It is important to understand that this is not a safety concern," Boeing says. "Existing systems such as radar provide the necessary positional data to [air traffic control] that allow the continued safe operation of the fleet."

Airservices Australia reported to ICAO in November 2015 that it could still consider imposing a blacklist label on the 787, meaning the agency could restrict the aircraft to operate below 29,000ft. Airservices Australia said it would base its decision on how quickly 787 operators implement Boeing's service bulletin to retrofit the in-service fleet.

Boeing says the "software update will restore full ADS-B functionality and its more efficient separations. In the meantime, the fleet continues to operate safely with standard separations." ■



**Spirits on the rise
at Renton as first
737 Max unveiled**
NEW FOCUS P10

THIS WEEK

ROTORCRAFT DOMINIC PERRY DONAUWÖRTH

Airbus to increase capability of H145

Helicopter manufacturer expands flight envelope of medium twin following high-altitude evaluations in Bolivia during 2015

Airbus Helicopters is hoping to capitalise on the smooth service entry of its new H145 – formerly the T2 variant of the long-running EC145 medium twin – and add extra capabilities to the baseline rotorcraft.

First delivery of the Donauwörth, Germany-built model – which gains uprated 900shp (671kW) Turbomeca Arriel 2E engines, a shrouded anti-torque rotor and new carbonfibre tail boom – took place in July 2014 to medical services provider DRF Luftrettung. Since then, 43 helicopters have been delivered to 14 custom-

ers, accumulating a total of 10,400 flight hours, says programme manager Dragos Grigorincu.

Availability is targeted at 85%, but Grigorincu believes it will be able to achieve over 90%.

Envelope expansion work has been carried out, with test flights conducted in April and May 2015 in Bolivia to enable a certificated density altitude of 20,000ft from 2016. The Helionix avionics suite will also gain additional features, including automatic dependent surveillance - broadcast out, a synthetic vision system, and digital maps.



Airbus Helicopters

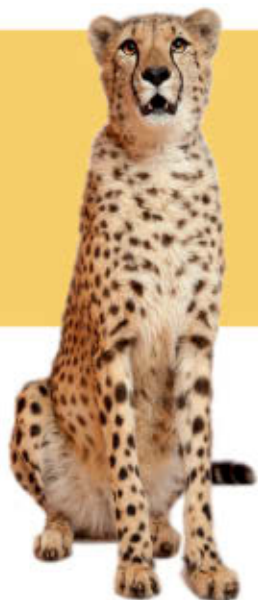
An iPad-based electronic flight bag is also being developed, says Grigorincu. A health monitoring system is being rolled out, which includes engine vibration monitoring, largely required by operators in the offshore transportation segment, he says.

Although around 80% of deliveries so far have been to the emergency medical services sector, offshore operators are increasingly showing interest in the eight-passenger helicopter.

That has been underlined by a firm commitment signed on 2 December for 10 H145s from Mexico's Pegaso for use in oil and gas operations. Deliveries are to start from 2017.

Backlog for the type now stands at 180 aircraft, representing a mixture of firm orders and options, says Grigorincu.

Production ramp-up of the new variant is ongoing, from 13 in 2014 to 40 in 2015, and rising to a maximum of 60 in 2016. ■



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PROGRAMME STEPHEN TRIMBLE SEATTLE

Spirits on the rise at Renton as first 737 Max unveiled

Low-key ceremony at revamped Seattle production facility is latest step towards service entry for re-engined narrowbody

Boeing unveiled the first 737 Max 8 flight-test aircraft – dubbed “The Spirit of Renton” – on 8 December, in a low-key employee and supplier-only ceremony scheduled 19 years after the 737-700 roll-out, and nearly 49 years after a champagne-soaked christening of the original 737-100.

The lack of public fanfare reflects a decision to focus the event on an internal audience, congratulating employees and suppliers who so far have kept the re-engining programme on time, says Keith Leverkuhn, Boeing vice-president and general manager for the 737.

Boeing even kept the aircraft’s official “roll-out” – when the 737 Max 8 moved from final assembly to a nearby paint hangar – a secret when it was completed on time on 30 November, Leverkuhn says.

“We wanted to thank our employees and our team,” Leverkuhn says. “All the milestones have been met. Engineering has been early. The supply

chain is performing well. When the airplane actually showed up here in the factory, the mechanics were ready to go. The parts teams were ready to go. So this is a celebration for the team.”

The public unveiling of the freshly-painted 737-8 in a unique teal livery marks a shift in focus for the four-year-old programme. Since completing the detailed design process a year ago, the emphasis has been on releasing parts to suppliers and assembling the first group of test aircraft.

NEXT TO APPEAR

The first aircraft – referred to as “1A001”, after the 787 programme retired the alphabetic prefix with “ZA001” – now enters pre-flight testing, as assembly continues on the remaining three test aircraft.

1A002 will be the next Max to appear, and has had its fuselage and wings mated and systems installed. Boeing machinists swung the landing gear – some 8in (20cm) longer than on the current-generation 737 to



accommodate the 69.4in fan diameter of the CFM International Leap-1B engines – for the first time on 7 November.

A tour inside 1A002 on the assembly line revealed a completed cockpit and a fuselage filled with partially completed test stations. No water ballast tanks were visible, suggesting 1A002 will be dedicated to testing the 737 Max’s new avionics and electrical systems.

“The milestones have been met. Engineering has been early. The supply chain is performing well”

KEITH LEVERKUHN
Boeing VP and general manager, 737

The redesigned tail cone for the 737 Max in final assembly presented a striking visual contrast with the aft fuselage of 737NGs on the adjacent “east” assembly line inside Boeing’s 4-82 hangar in Renton, Washington.

To improve the aerodynamics, Boeing added a 787-like, circular

tail cone to the 737 Max to fit around the exhaust vent of the Honeywell-supplied auxiliary power unit, eliminating the vortex generators found on the 737NG.

The wings for 1A003 also have arrived on the “central” assembly line, which is dedicated to supporting the 737 Max. The fuselage is still being completed inside a systems integration tool located in the adjacent 4-81 hangar, says Greg Batcher, director of the 737 Max assembly operations. The fuselage will soon be moved to the central line in the 4-82 bay, where it will enter the wing-to-body join position as the first step in the final assembly process.

No signs of the fourth flight-test aircraft were visible on a Boeing tour of the line, however. Leverkuhn says only that 1A004 will enter final assembly “later on”.

With Boeing officials already contemplating a 737 Max debut at the Farnborough air show in 2016, 1A004 is assigned the most high-profile role in the test programme. It will be the first of the evaluation aircraft to have a completed interior, including passenger seats, luggage compartments, galleys and lavatories.



Leap-1B engines should be 15% more fuel efficient than CFM56s

Jeremy Dwyer-Lindgen



SAA's A330 swap deal to go ahead despite concerns
AIR TRANSPORT P12



The first aircraft – 1A001 – will now enter pre-flight testing, as assembly continues on the remaining three test aircraft



Split-tip winglets will help contribute to the fuel-burn improvement

creasing compression levels for air entering the combustion chamber, which drives up temperatures inside the core.

Although no hotter than temperatures seen in the widebody engines of CFM's joint shareholder GE Aviation, the higher temperatures required Boeing to redesign a part of the engine nacelle that shields the thrust reverser from exposure to such heat. But the original plan to use a titanium inner wall raised concerns that Boeing supplier GKN could not deliver the part quickly enough.

MATERIAL DIFFERENCE

Boeing has decided to switch to a material developed for the GE9X engine, selected to power the 777X, Leverkuhn says. He declines to reveal the substitute material, but he says it is closer to the conventional composite substance used for such structures in previous nacelle designs.

GE's specific approach on the 777X engine inner wall is not known, but the company has recently developed a new material – oxide-based ceramic matrix

composites – to perform a similar role on the Passport engine for the Bombardier Global 7000 and 8000 business jets.

Boeing had accumulated 2,949 firm orders for the 737 Max before the first test aircraft rolled out of the factory, but that is still nearly 1,500 aircraft short of the backlog for the Airbus A320neo family. Despite its rival's 60% share of the market, Leverkuhn emphasises that Boeing launched the 737 Max nine months after the A320neo, when Airbus had already accumulated more than 800 orders.

Since the 737 Max was launched, Boeing's share of the single-aisle order market against Airbus is closer to 45%, but Leverkuhn describes that as "around 50%" of the segment.

"We're very comfortable with the way the market is settling out, which is 50-50 [market share split]," he says, adding that this is "not unlike where we are with the [737]NG and the A320 family right now. I would expect that to continue to go on. It's a dogfight in every campaign." ■

It will be used to perform an expanded set of trials that Boeing developed for the 737 Max.

"We're actually going to be doing things in the test card that we typically don't do," Leverkuhn says. "That is going to include things like performing step-climbs to understand how the engine is going to operate. We're going to really do things that only an airline would do."

FUEL CONSUMPTION

The Leap-1B powerplants for the Max are expected to deliver a 15% improvement in specific fuel consumption, compared with the CFM56 engines being delivered to customers today. Combined with the split-tip winglets, modified tail cone and other changes, Boeing still in-

"We're comfortable with how the market is settling out – it's not unlike the [737]NG and the A320"

KEITH LEVERKUHN

Boeing VP and general manager, 737

tends to deliver the 737 Max with a 14% overall fuel-burn reduction, Leverkuhn says.

Boeing has "good confidence" in CFM's ability to meet the fuel consumption target, he adds. The Leap-1B is now expected to receive engine certification shortly after first flight of the 737 Max 8 early next year, Leverkuhn says.

The Leap-1B is designed to improve fuel efficiency partly by in-

737 MAX IN NUMBERS

2,949

737 Max total firm commercial orders

41

Confirmed customers

201

Biggest single order, from Lion Air

647

Unidentified orders

SOURCE: Boeing orders to end-November



FINANCE GRAHAM DUNN LONDON

SAA's A330 swap deal to go ahead despite concerns

Nation's finance ministry insists that Airbus order revision proceed as planned, despite last-minute rand-deal request

South African Airways (SAA) has been instructed by the country's treasury to complete, as planned, a deal swapping commitments for 10 Airbus A320s for five A330-300s after judging there is insufficient time to further restructure the transaction to involve local finance.

The struggling carrier had hoped to amend the deal, struck earlier this year, in order to carry out sale-and-leasebacks with African lessors for the A330s. This would enable it to secure savings through having the lease deals denominated in South African rand rather than US dollars.

But with the swap transaction with Airbus needing to be completed during December, South Africa's finance ministry has blocked the move, believing the risk of defaulting on payments if

lease deals are not struck in time outweighs the possible savings.

SAA decided to switch its order earlier this year to finally draw a line under an onerous commitment for 10 A320s dating from a wider 2002 deal.

The problem for SAA was that the acquisition price for the narrowbodies could have exceeded their current market value due to escalation clauses in the original contract.

To address this, SAA negotiated a deal to cancel the remaining 10 A320s and acquire five A330-300s on operating leases, in turn generating cost savings through allowing it to phase out its A340-600 fleet.

SAA will also be reimbursed for pre-delivery payments that have already been made on the 10 A320s and will not be liable



Acquisition costs for 10 A320s were a potential burden for carrier

for any outstanding payments on the aircraft.

Despite the deal being confirmed in September, SAA subsequently informed finance minister Nhlanhla Nene it was reviewing the transaction structure with a view to amending it to take advantage of leases denominated in the local currency, rather than US dollars.

Nene agreed to SAA exploring the possibility, but stipulated any deal must leave SAA in a better financial position and mitigate the risk of not completing the planned swap transaction in time. While SAA and treasury as-

sessments indicate possible benefits from entering a rand-denominated lease, Nene has blocked the application to amend the swap.

"In the absence of having identified the financial institution that would act as the lessor, SAA would be required to make the immediate payments [PDPs] that would become due. SAA has acknowledged it is not in a financial position to afford the PDPs," the ministry says. "A default by SAA would have severe negative consequences for SAA and could have spillover consequences for the country as a whole." ■

POLITICS OLIVER CLARK LONDON

Superjet frozen out by Riga's Air Baltic rescue plan

Air Baltic is likely to be forbidden from ordering the Sukhoi Superjet under a clause in the shareholder agreement due to be signed by the Latvian government and the carrier's prospective new investor Ralf-Dieter Montag-Girmes, chief executive Martin Gauss discloses.

Speaking to *Flight International*, Gauss says the clause, which was inserted into the agreement by the Latvian government, prevents the Riga-based carrier from acquiring or leasing any aircraft from a company linked to a "military-industrial complex" that is subject to European sanctions.

While the clause does not name Sukhoi specifically, Gauss confirms that because the manu-



Carrier could add Bombardier CRJ1000 regional jets to Q400 fleet

facturer is owned by Russia's United Aircraft – which is currently subject to EU and US sanctions – Air Baltic would not be allowed to order the Superjet.

The condition was part of a motion approved by the Latvian parliament on 3 December giving the government the green light to invest €80 million (\$85 million)

in Air Baltic as part of a deal under which Montag-Girmes will invest a further €52 million for a 20% stake in the airline. Gauss says the shareholder agreement could be signed shortly and adds the terms "are more or less agreed" between the two parties.

Under its "Horizon 2021" business plan, Air Baltic has issued a tender for five 100-seat jets and confirms it is evaluating the Embraer 190, the Sukhoi Superjet and the Bombardier CRJ1000.

Gauss says "there are other aircraft out there" and that once the shareholder agreement is signed new orders could be placed "within weeks or months". He adds: "we are pretty advanced in what we are proposing to do". ■



**Qatar pilots erred
in Miami departure**
AIR TRANSPORT P15

INQUIRY DAVID KAMINSKI-MORROW LONDON

'Improper' operation led to ATR crash

Turboprop written off after bounced landing in strong crosswinds, as experience gap inhibited communication on flightdeck

Investigators have disclosed that a Carpatair ATR 72-500 captain breached operating procedures while attempting an approach to Rome in strong gusting crosswinds, before a bounced landing that badly damaged the aircraft.

The aircraft had been operating a service to Rome Fiumicino on behalf of Alitalia on 2 February 2013. The crew had been informed of 22kt (41km/h) winds gusting to 37kt.

"The captain had conviction about his ability to land the aircraft safely, despite the weather"

ANSV

These gusts exceeded the operating limits for the aircraft. However, cockpit-voice recorder information shows the crew did not carry out a landing briefing – during which the pilots would normally have discussed the weather situation at the destination and alternate airports.

The night-time approach to runway 16L was flown at 130kt, which, says investigation authority ANSV, was "significantly" higher than the 118kt normally expected.

But the ANSV points out that the first officer – with less than 15h on type – was far less experienced than the captain, who had over 9,600h on ATRs.

UNCRITICAL

This huge difference probably "inhibited" the first officer's ability to speak out about the situation and she accepted uncritically the airspeeds communicated by the captain, who was flying.

The ANSV says the captain had "conviction" about his ability to land the aircraft safely, despite the weather situation, and

the pilots' experience gap rendered crew-resource management techniques "ineffective".

The turboprop struck the runway with 2.6° nose-down pitch, some 560m (1,840ft) from the threshold, and bounced off its nose-gear.

Its crew did not attempt a go-around after the impact. The ANSV says the pilots made opposite control inputs after the bounce – the captain pushing down while the first officer pulled up – which decoupled the flight controls.

The aircraft contacted the runway a second time, badly damaging the nose-gear and interrupting the power to the engines as a result of impact forces on the cockpit control levers.

DECOUPLING

The ANSV says this second impact compromised "any possibility of recovery" for the landing. The decoupling led the ATR to roll slightly left and it bounced off each main landing-gear, damaging both. The aircraft subsequently slid on its fuselage underside for some 400m and rotated nearly 180° as it veered



The ATR slid for 400m on its fuselage, coming to rest on grass

off the runway and came to a halt on grass.

None of the 50 occupants were seriously injured. The investigators have cited "improper" operation of the aircraft by

the captain which was "not consistent" with the carrier's procedures in critical conditions.

The aircraft (YR-ATS) was a 1997-built example and was written off in the incident. ■

ANALYSIS DAVID KAMINSKI-MORROW LONDON

Manufacturer defends operating limits in face of criticism

Romania's air transport safety authority believes that crosswind operating limitations for ATRs should be lowered in order to reduce the risk of difficulties during approach and landing.

The country's civil aviation investigation and analysis centre (CIAS) claims that ATR operators, including Romanian flag-carrier Tarom, have found the turboprop's response to be "very unpredictable" in gusts close to the maximum permitted by the manufacturer.

The centre's comments follow the Italian investigation into a landing accident at Rome involving an ATR 72-500 operated by Romanian airline Carpatair.

The CIAS says that a technique to avoid sinking, by increasing the approach airspeed, can lead to a pitch-down attitude and a possible nose-gear impact.

Although the ATR 72's manufacturer puts the maximum crosswind limit for the type at 35kt (65km/h), the centre says that Tarom has reduced this to 30kt.

ATR sets a similar 45kt limit for the smaller ATR 42.

The Romanian centre claims that a pilot with "average skills" is "not able" to perform a safe approach, particularly at night, at the higher limits set by ATR.

It cites several occurrences in which ATRs have suffered incidents

or accidents under similar circumstances to those experienced by the Carpatair crew.

It insists that the crosswind limits for the turboprop type "must be reduced" and that "immediate action" to this effect should be required from ATR.

However, the manufacturer points out that crosswind limits for its aircraft are not fixed thresholds and carriers should adapt them to suit their own operation.

ATR also emphasises the Carpatair inquiry's conclusion regarding the excessive approach speed of the aircraft. The airframer says it recommends "adherence to the quoted approach speeds". ■



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**RAF Typhoon deploys
Paveway IVs after
parliamentary vote**
DEFENCE P16

SAFETY DAVID KAMINSKI-MORROW LONDON

Qatar pilots erred in Miami departure

Crew began take-off roll from intersection, cutting 1,000m from available length, causing 777 to clip lights as it left ground

Investigators have revealed that a departing Qatar Airways Boeing 777-300ER overran the runway at Miami airport before becoming airborne and striking approach lights as it climbed away.

The inquiry into the accident has disclosed that the captain chose to depart from the T1 intersection of runway 09 despite carrying out the calculations for a full-length runway departure, and despite a prohibition on intersection take-offs from this runway.

It indicates that the root of the event lay partly in the terminology displayed by the take-off calculation tool within the aircraft's electronic flightbag.

FULL-LENGTH

This tool offered the pilots only a single take-off option, displayed to the crew as '09#T1'. The Qatari civil aviation authority, which has released a series of preliminary findings, says the pilots "understood" that this referred to a full-length take-off, adding that the tool "displayed" the information that intersection departures for this runway were not permissible.

But Miami's runway 09 coincidentally has an intersection designated 'T1'. As the 777 (A7-BAC) taxied parallel to the runway, in darkness, the captain "decided" that the aircraft could depart from this intersection.

The captain "could not recall" his reasons for the decision, says the inquiry, but says he believed the information subsequently printed by the calculation tool displayed the label '09#T1' in a "compelling way".

This printed information did not mention that intersection de-



Pilot of the affected airliner initiated rotation with only 300m of available runway remaining

partures were not permitted from runway 09.

When the first officer was asked to tell air traffic control about the intersection departure plan, he checked his own notes, in which he had referred to the 'T1' label used by the tool. This convinced the first officer that the T1 intersection was acceptable as a line-up point for take-off and advised controllers accordingly.

The flightcrew included a relief captain and first officer, both in the cockpit. They queried the decision to use the T1 intersection but, during the subsequent conversation, came to believe they had missed the pilots' re-calculation of the take-off performance to account for the shorter departure.

Although the captain – who had nearly 1,000h on type – had been tracking the 777's taxi route on a cockpit display, the short-

range view selected disguised the position of T1 relative to the rest of the runway.

None of the four crew members realised that the T1 intersection was some 1,000m from the beginning of runway 09, leaving the 342t aircraft with only 2,610m available for the departure.

MOUNTING CONCERN

The false perception was further reinforced by an aircraft which, as a result of a displaced touchdown, landed close to the 777's position.

As the aircraft rolled for take-off the crew started to become concerned as it approached the V1 decision speed.

"The [captain] assessed the speed of the aircraft, the rate of acceleration and the runway remaining and concluded the safest course of action was to continue," says the inquiry.

It states that the captain recalled initiating rotation with only 300m of runway remaining.

Flight-data recorder information shows the ground roll was 2,866m and the 777 was "still on the ground" as it left the runway area. The subsequent collision with approach lights for runway 27 was captured on surveillance cameras. None of the crew was aware of the impact and the aircraft – operating flight QR778 to Doha on 16 September 2015 – landed without further incident.

But inspection of the aircraft showed it had suffered a 46cm tear in its fuselage, which breached the pressure vessel, behind the rear cargo door. The inquiry says the aircraft sustained damage across 18m² of aircraft skin, as well as parts of its main landing-gear, with 90 individual areas needing assessment. ■



SURVEILLANCE

BETH STEVENSON LONDON

Ankara's final Peace Eagle reports for duty

Boeing delivered a fourth 737-700-derived Peace Eagle airborne early warning and control (AEW&C) system aircraft to the Turkish air force at Konya air base on 9 December, completing Ankara's acquisition of the type.

Under a \$1 billion contract signed in 2002, the platform was developed by Boeing and radar supplier Northrop Grumman, with local partners including Turkish Aerospace Industries and Havelsan. The programme's first three aircraft were delivered in 2014.

The AEW&C configuration includes 10 onboard operator consoles, enabling the simultaneous tracking of airborne and maritime targets. Battle management capabilities "allow mission crew to direct offensive and defensive forces while maintaining continuous surveillance", Boeing says. ■

ARMAMENTS BETH STEVENSON LONDON

RAF Typhoon deploys Paveway IVs after parliamentary vote on Syria

An early December parliamentary vote to extend UK operations against Islamic State militants into Syria has led to the deployment of additional strike aircraft to the Royal Air Force's Akrotiri base in Cyprus, and the demonstration of a new combat capability for the Eurofighter Typhoon. Shortly after the approval, an extra two Panavia Tornado GR4s were deployed, joining eight already assigned to support the US-led Operation Inherent Resolve in Iraq.

Six Eurofighter Typhoon FGR4s arrived in Akrotiri, marking the type's first combat commitment since its UK strike debut in NATO's Libya campaign of 2011. During a 4 December mission, a Typhoon used Raytheon Systems Paveway IV precision-guided bombs to attack the Omar Oilfield in Syria, which the UK Ministry of Defence says is a primary source of income for IS. RAF



Eurofighter gained precision-strike weapon through P1Eb upgrade

Tornados had used the 226kg (500lb)-class weapon to strike six targets at the same site the previous day. The first offensive use of a Paveway IV by an RAF Typhoon was enabled via the P1Eb capability enhancement.

Strike missions in the UK's Operation Shader are supported by coalition assets including an RAF

Airbus A330 Voyager tanker, General Atomics Aeronautical Systems MQ-9 Reaper unmanned air vehicles, and Boeing RC-135W Rivet Joint and Raytheon Sentinel R1 surveillance aircraft.

Germany's parliament voted to deploy six reconnaissance-tasked Tornados, an in-flight refuelling aircraft and 1,200 personnel. ■

PROGRAMME LUCA PERUZZI GENOA

First Italian-made F-35A is delivered

Lead Joint Strike Fighter from nation's planned 90-aircraft acquisition is accepted at its Cameri final assembly facility

Italy has received its initial Lockheed Martin F-35A – the first example of the stealth type assembled outside the USA.

The Joint Strike Fighter (JSF), aircraft AL-1, was handed over to the nation's defence ministry on 3 December, during a closed-doors ceremony at Italy's final assembly and check out facility at Cameri air base.

It will remain at the site for pilot familiarisation before being transferred in early 2016 to Luke AFB in Arizona, where it will support training. During its flight to the USA it will be accompanied by an Italian air force Boeing KC-767A tanker.

Two of the service's pilots have begun receiving instruction on the JSF, and flew F-35s for the first



First two air force pilots have already begun training using AL-1

time on 6 November in the USA.

Aircraft AL-1 performed its maiden sortie on 7 September and Rome's second F-35A – AL-2 – will make its first flight in the coming weeks, ahead of planned

delivery in February 2016. This, along with three further Italian-completed examples, will also subsequently transfer to the USA. Aircraft AL-6 will be the first Italian-assembled JSF destined for

a frontline unit, with the delivery milestone scheduled for late 2016.

In addition to final assembly work, the Cameri facility – which is owned by the defence ministry but operated by Alenia Aermacchi – also produces wing shipsets for the F-35. Three full wing assemblies have been delivered, with a least another dozen in varying stages of completion.

Italy has indicated its intention to acquire 60 conventional take-off and landing F-35As for the air force and 30 short take-off and vertical landing F-35Bs, to be split between the air force and navy. Rome has so far placed orders for eight A-model aircraft. An April 2015 defence white paper suggests a purchase of 38 examples in the period to 2020. ■



Surplus Hercules offered to France
DEFENCE P18

TRAINING ELLIS TAYLOR SINGAPORE

PC-21 contract lift for Australian pilots

Lockheed Martin, Pilatus and Hawker Pacific will supply 49 turboprop trainers and seven simulators under tri-service deal

A consortium led by Lockheed Martin has been awarded a A\$1.2 billion (\$870 million) contract to train Australian Defence Force (ADF) pilots using Pilatus PC-21 turboprops.

The 'Team 21' consortium, which also includes Pilatus Aircraft and local maintenance, repair and overhaul provider Hawker Pacific, had been announced as the preferred tenderer for the pilot training system requirement in September 2015.

Included in the deal is the acquisition of 49 PC-21s, seven flight simulators and updated courseware for an initial seven-year term, starting from 2019.

Defence minister Marise Payne says the deal will ensure that undergraduate pilots across the Royal Australian Air Force, Royal Australian Navy and Australian Army will be better equipped to transition to types such as the Lockheed F-35 and NH Industries MRH90 multi-role helicopter.

"For the first time in Australia, pilot training will include simula-



Operational use of the Swiss-built type will start during 2019

tors in undergraduate training. This will become the new benchmark for training and preparing military pilots for fourth- and fifth-generation platforms," she adds.

The Australian Department of Defence says the new arrange-

ments will also allow the ADF to increase the number of graduate pilots from 77 to 105 per year.

Under the teaming arrangement, Lockheed will provide overall project management for the training system, with Pilatus

to deliver the aircraft – from June 2017 – and through-life support. Hawker Pacific will provide maintenance services and fleet support in Australia.

The ADF will continue to provide instructors for the programme, which will see basic training at RAAF Base East Sale in Victoria. Advanced flying training will continue at RAAF Base Pearce in Western Australia.

The Team 21 partners already operate a similar training system for the Republic of Singapore Air Force's Basic Wings course, which is conducted at Pearce also using the PC-21. This recently passed the 50,000 flight hour and 300 students trained milestones.

The winning team competed against a rival bid by BAE Systems, CAE Australia and Beechcraft, which had proposed a system based around the latter's T-6C platform. BAE is the incumbent contractor for the ADF's PC-9-equipped Basic Flying Training School in Tamworth, which will close in 2019. ■

ROTORCRAFT DOMINIC PERRY LONDON

Indonesia grounds VIP helicopter acquisition

AgustaWestland's hopes of selling three VVIP-configured AW101 helicopters to Indonesia appear to have been dashed, after the country's leader, Joko Widodo, rejected an air force plan for their acquisition.

In late November 2015, the head of the air force, Air Marshal Agus Supriatna, said the service had selected the UK-built, 15.6t rotorcraft, noting there was no Indonesian-built alternative.

Acquisition of the AW101s for the air force's 45 Sqn was part of its strategic equipment plan for 2015-2019, he said.

However, following a 3 December cabinet meeting to discuss defence procurement,

Widodo "decided to disapprove a plan to buy the helicopter[s]", according to local media reports quoting cabinet secretary Pramono Anung. The decision was made because the presidential helicopter is still serviceable, and the "price is too high" for the AW101s. The president has ordered the procurement of a locally-assembled helicopter, or one with significant local content, reports suggest.

Flightglobal's Fleets Analyzer database records the Indonesian air force as operating one Airbus Helicopters AS332 for VIP transportation. The service also has received five of 15 Airbus Helicopters H225M transports. ■



ACCEPTANCE

Spain takes delivery of second NH90

NH Industries (NHI) has delivered the second of 22 NH90 troop transport helicopters to the Spanish army. Handed over at the Albacete production line of the European consortium's majority shareholder Airbus Helicopters on 4 December, the 11t-class rotorcraft was the 28th delivery for the programme in 2015, and the 260th in total.

NHI had forecast delivering around 50 helicopters in 2015. The latest aircraft's transfer is the first delivery to Madrid since a significant contract revision was agreed, cutting its order from 45 to 22. Spain's NH90s are powered by GE Aviation CT7 engines. Italy's AgustaWestland and Fokker, of the Netherlands, are also partners in NHI.



TRANSPORTS ARIE EGOZI TEL AVIV

Surplus Hercules offered to France

Israeli firm planning unsolicited offer after Paris issues request for proposals to rival C-130 support specialists

Israel Aerospace Industries' (IAI) Bedek group will make an unsolicited proposal for the supply of four upgraded Lockheed Martin C-130Es to the French air force. Sources in France confirm that they expect to receive an offer from IAI.

France's DGA defence procurement agency recently issued a request for proposals for the purchase and modification of four C-130s to Marshall Aerospace and Defence Group, Ogma and Sabena Technics.

According to the request, the French air force wants to acquire four C-130s in an operational condition, and with centre wing-boxes that will allow them to log another 20-30 years of use. Two of the Hercules must also be

equipped with an air-to-air refuelling system.

Bedek is one of five worldwide maintenance, repair and overhaul centres with experience of centre wing-box replacement, with the activity performed as part of a C-130H life-extension project for the Israeli air force.

French sources suggest IAI would perform the upgrade and depot maintenance with a local company, if selected.

The Israeli air force is phasing out its C-130Es as the upgrade programme to its H-model aircraft continues. The availability of surplus aircraft from its inventory could involve a government-to-government arrangement. IAI declines to comment on the details of the unsolicited proposal.



Michal Weissbrod/Israeli Air Force

Bedek's past experience in centre wing-box replacement is key

In addition to investigating the potential secondhand C-130 buy, France has requested information on the possible purchase of two new-generation C-130Js and the same number of KC-130Js via the US government.

Part of its requirement stems from the need to refuel Airbus Helicopters H225M Caracal rotorcraft in-flight. Trials with the

Airbus Defence & Space A400M – 50 of which are on order for its air force – showed the Atlas was unsuitable.

Flightglobal's Fleets Analyzer database records the French air force as currently operating 14 H-model Hercules, which vary between 24 and 40 years in age. ■

Additional reporting by Craig Hoyle in London



Anthony Pecchi/Airbus Helicopters

ARMAMENTS

Exocet work on target for Brazil

Helibras has completed the first stage of laboratory work to integrate MBDA's AM39 Exocet anti-ship missile onto the Airbus Helicopters H225M rotorcraft it is building for the Brazilian navy.

During three weeks of testing, the team completed simulated launches, the Airbus Helicopters subsidiary says. The activity is designed to verify the link between the missile launchers and the naval mission system in the rotorcraft, test modes of operation and validate flight-test instrumentation. Sorties with the munitions will be performed in early 2016, Helibras says. Activities are being co-ordinated from Helibras's Itajuba engineering centre with Airbus Defence & Space, Airbus Helicopters, Embraer subsidiary Atech, and MBDA. The mission system for the 16 Brazilian navy helicopters has been developed locally by Helibras.

The service has received seven of the 11 rotorcraft, with the army and air force each having received five helicopters from orders for 16. ■

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PRODUCTION STEPHEN TRIMBLE WASHINGTON DC

Sales dip prompts Gulfstream jobs cut

After recruiting 1,000 new staff from 2010, weakness in large-cabin business jet market dictates losses of similar scale

Gulfstream is reducing its workforce by nearly 7%, a month before releasing production rate plans for 2016. The end of year lay-off includes about 600 contractors and around 500 employees in indirect support positions, Gulfstream says.

A routine internal evaluation recommended “streamlining our business to position Gulfstream for continued success”, the company adds. The move is the first publicly announced staff change since 2010, when Gulfstream revealed plans to hire up to 1,000 workers over five years.

At the time, the company was

increasing production rates of the G450 and G550 and completing certification of the G650 – which is now in full-rate production – and the super mid-size G280.

It would not be revealed until four years later, but Gulfstream also in 2010 kicked-off design and development of two new large-cabin and long-range jets – the G500 and G600.

The new models will enter service in 2018 and 2019, respectively, and Gulfstream officials have emphasised that they are intended to complement – rather than replace – the G450 and G550.

But demand for products in the

large-cabin segment appears to be falling. Rival Bombardier has already slashed production rates in 2016 for the Global 5000 and Global 6000 jets by nearly half.

Gulfstream has been able to keep G450 and G550 deliveries going at a steady rate. But FlightGlobal’s Fleets Analyzer database indicates combined deliveries of G450s and G550s declined from 80 in 2013 to 67 in 2014.

With nearly a month of delivery activity still to come, Gulfstream had delivered 48 G450s and G550s, combined, through November 2015, our data shows.

But delivery rates can fluctuate

depending on the amount of completion work clients need after jets roll off the assembly line.

Gulfstream’s assembly lines in Savannah, Georgia, may not be running at peak 2013 levels, but they have not been sharply reduced either.

“Our production rate remains largely unchanged for this year,” Gulfstream says. “We are evaluating 2016 production rates right now, and [parent company] General Dynamics will announce those in late January as part of the year-end earnings call. As such, we can’t make any comments about 2016 rates.” ■

SHIPMENT KATE SANSFIELD LONDON

‘Fastest-selling TBM’ races to 100th delivery

Daher has handed over the 100th TBM 900, 20 months after the latest iteration of the long-running single-engined turboprop line entered service.

Nicolas Chabbert, senior vice-president for Daher’s airplane business unit, describes as “symbolic” the 7 December handover to an unnamed US customer. “The delivery confirms that our TBM 900 not only is the fastest single turboprop, but also the fastest-selling TBM ever – as the programme was officially unveiled in March 2014.”

According to the US General Aviation Manufacturers Association, Daher delivered 36 of

the Pratt & Whitney Canada PT6A-66D-powered aircraft in the first nine months of 2015, of which 11 were handed over in the third quarter. The 900 is an upgrade of the TBM 850, itself a refresh of the first-generation TBM 700.

The \$3.8 million TBM 900 was in development for over three years in Tarbes, southwest France. It incorporates 26 modifications to boost efficiency, performance and comfort. These include winglets, a vertical tailfin strake, five-blade composite propeller, revamped electrical system and restyled cockpit panel. As of 30 November, the global TBM fleet stood at 760 aircraft, says Daher. ■



Malcolm Nelson

ACCIDENT

Morgan Freeman in SyberJet drama

A SyberJet SJ30-2 owned by actor and pilot Morgan Freeman was forced into an emergency landing at Tunica Municipal airport in Mississippi on 5 December en route to Sugar Land regional airport in Houston. According to a US Federal Aviation Administration accident and incident notification the light business jet – registration N30GZ – diverted to Tunica at 17:15 local time and ran-off the runway “following a reported possible blown tyre and hydraulic problem”.

Neither Freeman nor his pilot was hurt in the incident, and the twinjet suffered minimal damage. In a statement to *Flight International*, SyberJet says “it is supporting the FAA and the National Transportation Safety Board investigations”.

Freeman has been an ambassador for the SJ30 programme since taking delivery of his aircraft – serial number 10 – in 2009. The Hollywood actor is also the launch customer for the upgraded SJ30i, which is scheduled to enter service in 2016 featuring the Honeywell Primus Epic 2.0-based SyberVision cockpit, and the longer-range SJ30x, which will follow a year later.



The TBM 900 reached the milestone within 20 months

Daher



25 most
memorable
moments of 2015
FEATURES P22

OUTLOOK STEPHEN TRIMBLE WASHINGTON DC

Lockheed downbeat on civil helicopter forecast

Lockheed Martin has seen the outlook worsen for the commercial helicopter market since acquiring Sikorsky, says chief financial officer Bruce Tanner.

Speaking to investors and analysts at a Credit Suisse conference in December, Tanner said that consultants hired by Lockheed while conducting due diligence on the acquisition, had already taken a more pessimistic outlook on the market recovery than had Sikorsky's then-parent United Technologies.

Lockheed's estimates may have been closer to the mark,



Tanner says, but it was still too optimistic compared with the company's current forecast for a market rebound. "When does the rebound sort of occur? I think

that may be a little bit further to the right," Tanner says.

A five-year boom in demand for large commercial helicopters evaporated last year as oil and gas

companies scaled back offshore exploration and drilling due to falling prices.

"That pressure has not backed off any," Tanner says. "Arguably it's a little tougher than when we started [evaluating Sikorsky]."

Sikorsky has seen deliveries of its two commercial models – the S-76D and S-92 – dry up over the last year. But Sikorsky's defence business has more near-term growth potential, if the company can make a successful transition from development into production on five major programmes, Tanner says. ■

OPERATIONS DOMINIC PERRY ABERDEEN

Oil crisis prompts rotorcraft rethink

Operator CHC Helicopter and its customers have had to work more collaboratively in order to realise cost savings

Fundamental changes have taken place to the relationship between CHC Helicopter and its customers in the North Sea region as each party works to survive the effects of the plunging oil price.

That is the view of Mark Abbey, regional director for the Western North Sea at CHC, who believes the oil and gas industry in Aberdeen, UK has reacted in a "collaborative" way to deal with the ongoing crisis.

"Without exception we have

approached each other with mutual understanding to work together to find our way through the market conditions," he told reporters in Aberdeen in the run up to the release of the company's second quarter results.

Both the operator and its customers are seeking cost savings to address the current market, says Abbey. But a change in attitude is required if some efficiencies are to be implemented, he adds.

"If you look at [helicopter flights] as an unstructured limou-



Flight activity in Aberdeen has fallen by about 20% since 2014

sine service rather than a scheduled service then costs will remain the same," he says.

However, the majority of customers in the North Sea, which has seen a 20% reduction in flight activity over the past 12

months, have been receptive to the changes to schedules, which have become "more structured and regular".

In addition, some oil and gas clients have accepted shared-use helicopters, instead of contracting them exclusively.

Its workforce has also helped. Pilots accepted a reduction in hours to around 85% to minimise compulsory redundancies, says Abbey.

But even when the oil price recovers – and most analysts are predicting a prolonged downturn – Abbey cautions many of the changes are here to stay.

"The improvements we are making today to try and combat the oil price will have to stay in place to make us efficient," Abbey says. ■

FINANCIALS DOMINIC PERRY LONDON

Tumbling crude prices drive down revenues – and orders

The latest quarterly results from Canada-headquartered CHC – released as Brent crude dropped briefly below \$40 per barrel – show how deeply the crisis in oil and gas is affecting offshore transportation.

Revenues from its helicopter services business for the three-months ended 31 October dropped 22% to \$325 million, down from \$417 million in the same period of 2014.

For the half-year, revenues fell 21% to \$665 million, from \$841 million. Second quarter net losses for the entire business – which includes maintenance operation Heli-One – were at \$42 million, albeit an improvement on the \$177 million net loss recorded for the same period a year earlier.

Order commitments at CHC are now at an "historic low" it says,

with just \$258 million allocated for new helicopters, down from an early 2014 high of \$878 million.

Discussions with the airframers on order flexibility continue, says chief executive Carl Fessenden, as all sides react to "the market realities we are seeing today".

"We believe we are having progress in those discussions," he told a 9 December analyst call. ■



most memorable moments of 2015

The year saw airline disasters caused by human frailty and terrorism but also celebrated some milestone industry moments, with Airbus and Boeing initiating unprecedented production rate rises, China and Japan stepping onto the world stage and Lockheed Martin and Dassault breaking fighter barriers. Technology shone, too, with solar- and electric-power records falling in dramatic fashion and astronauts on the space station finally getting a proper cup of coffee



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◆ Rafale breaks out

Egypt ordered 24 Dassault Rafale fighters in February and took delivery of the first three in July. Qatar signed a firm order for 24 Rafales in May.

Both orders break a decade-long export barrier for the French air force's premier multi-role fighter, relieving the defence ministry in Paris of the full financial burden for supporting the type.

Until 2015, the Dassault and French government sales effort had yielded a string of at least six failed bids, including Brazil, Kuwait, Libya, Singapore, South Korea and Switzerland. The export deals in 2015 also emerged rapidly compared to years-long negotiating marathons in other countries.

India selected the Rafale for a 126-aircraft deal in 2009, but efforts to consummate the order have stalled. It appeared earlier this year that both sides were close to resolving a dispute over Dassault's liability for Indian-made Rafales. But plans to close the deal by July never came to fruition and the talks continue, for 36 aircraft.

A similar delay has unfolded in the United Arab Emirates, which also selected the Rafale in 2009. But negotiations to complete that order for up to 60 aircraft also have stalled, with no update offered from either side during the Dubai air show in November.

However, the Rafale continues to look for more export deals. As 2015 came to a close, the sales campaign stretched from Malaysia to Finland to Canada, where the Rafale is competing against a familiar crop of rivals for major fleet deals.



ECAD/EMA/SPA/Rex Shutterstock

Airbus Helicopters unveils the H generation

Airbus Helicopters has been promising the world a new medium-weight, twin-engined rotorcraft since the days when it was still Eurocopter, but the eventual size and shape – and indeed name – remained something of a mystery. In March, the manufacturer finally revealed the H160 to the world. Intended as a replacement for the AS365 Dauphin and H155 and a response to the AgustaWestland AW139 – and dubbed the “AW139 killer” by chief executive Guillaume Faury – the helicopter is billed the “first of the H generation”, reflecting the changes at the company since it gained the Airbus branding. Key to the H160 is its relative simplicity, particularly when compared with initial designs when it was still called X4. Gone are the highly complex cockpit display and fly-by-wire controls, to be replaced by more conventional systems. Gone too is a choice of engines, with the Pratt & Whitney Canada PW210 and a quest for more power giving way to the 1,100-1,300shp (820-969kW) Turbomeca Arrano as sole powerplant. However, the new rotorcraft still features a host of advanced features, including a



shrouded tail rotor canted at 12°, a biplane rear stabiliser, and curved Blue Edge rotor blades. Thanks to its adoption of a new way of designing and building helicopters – during which dynamic and electrical systems are matured before the aircraft takes to the skies – the H160 has moved forward quickly. First flight came in June, shortly

before the Paris air show, with a second prototype due to join the test fleet by year-end. More details on the precise specification of the H160 should emerge as testing progresses in 2016. The manufacturer will also open its order book next year, which should give a clear indicator of the H160's popularity.



Bombardier: not all good news

Bombardier had a few bits of good news in 2015. The CSeries (*pictured*) was on track to be certificated by the end of the year, as this article went to press. Flight tests had confirmed the CS100 met or beat promised performance goals. And the company is now led by a strong cadre of well-known and respected executives plucked from some of the industry's biggest manufacturers, lessors and airlines.

But there was also bad news for the Montreal-based manufacturer in 2015. Okay, lots of bad news. In February, Bombardier chairman Laurent Beaudoin was forced to retire as the company reported a \$1.4 billion write-down on the “paused” Learjet 85 programme. In July, Bombardier announced a two-year delay for the Global 7000, to redesign the wing. The company added another \$1.2 billion charge on the Learjet 85, and finally cancelled it. More ominously, it announced a \$3.2 billion write-down on the CSeries. It has been 15 months since a customer signed a new firm order for a CSeries aircraft.

The Quebec government has stepped in to help salvage the company's finances, pledging to invest \$1 billion in a new CSeries joint venture in 2016. Canada's federal government is also in discussions with Bombardier to inject more cash.

JF-17 wins an order

A stock question for years has been to ask Pakistan air force and China defence export agency CATIC officials when the JF-17 fighter, made by Islamabad and Beijing, would win its first export order. At the Paris air show in June, *Flight Daily News* scored a scoop when a programme representative revealed a first customer. Months later, at the Dubai air show, Pakistani officials confirmed the deal – but not the customer's identity, the number of aircraft or delivery dates. The sale is a key milestone for a fighter billed as a low-cost, high-capability jet for developing world air forces.





Rate expectations

Airbus waited until the last days of October before confirming what many suspected: that it intends to raise output of its best-selling narrowbody to previously unheralded levels. From mid-2019, the airframer will produce 60 A320neo-family jets each month across its four final assembly lines in Toulouse, Hamburg, Tianjin and Mobile.

Its analysis of its order book suggests the backlog for the re-engined narrowbody – presently at over 4,400 and rising – is sufficiently robust to support the increase. Discussions with key suppliers – particularly engine manufacturers CFM International and Pratt & Whitney – have given Airbus confidence the supply chain can cope with unprecedented levels of output.

The manufacturer had already committed to taking output to 50 A320-family jets per month from 2017, with Boeing taking production of its competing 737 to 52 per month. Airbus's move, of course, puts pressure on the Seattle airframer to match the increase. The opening of a third production line in Renton, Washington creates capacity at the final assembly stage for Boeing to build as many as 63 737s. Spirit AeroSystems, which supplies the narrowbody's fuselage, has made similar capacity adjustments at its manufacturing site in Wichita, Kansas. Boeing, too, has made changes to its Renton wing assembly line to support the higher rate. But now it is a matter of persuading the supply chain, especially engine manufacturer CFM, which has exclusivity on both the current-generation 737 and the re-engined Max, to ramp up production as well. However, all of that has to be considered in the context of rate rises on other programmes: Boeing intends to push the 787 to Rate 12 in 2016 and Rate 14 by the end of the decade, as Airbus struggles to meet ramp-up targets on the A350.



Boeing orders pace cools

Boeing set an internal orders record a year ago, but it couldn't maintain the pace in 2015.

The company's net order tally in 2014 rose to 1,432 aircraft overall, a figure swelled by demand for new models such as the 737 Max, the 777X and the 787-10.

By the end of November, however, Boeing's year-to-date net orders in 2015 stood at just 568. Boeing chief salesman John Wojick pledged at the Dubai air show in mid-November to sign as many orders by the end of the year as the company would deliver: 755-765 aircraft.



Mentally ill pilot kills 150

When a Germanwings Airbus A320 en route from Barcelona to Dusseldorf crashed in the French Alps on 24 March, killing all 150 on board, the rarity of catastrophic problems in the cruise phase of flight immediately rang alarm bells that this had been no ordinary disaster.

Sadly, early concerns proved justified when the recovered cockpit voice recorder showed the captain to have been locked out of the cockpit as the aircraft began its descent from 38,000ft, apparently at the deliberate control of co-pilot Andreas Lubitz, who had not responded to numerous radio calls from air traffic control. Amid anguished tributes (*pictured*), realisation the aircraft had been deliberately crashed prompted calls for two crew at all times in the cockpit and reviews of post-9/11 cockpit door locking routines. But there may be no complete protection from mental illness.



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MRJ flies

On 11 November, Mitsubishi Aircraft finally got its MRJ regional jet off the ground. In a 90min sortie from Nagoya International airport, the aircraft performed very well, according to test pilots. During the much-anticipated flight, the crew looked at the basic characteristics and functionality of the aircraft in ascent, descent and turning.

The first flight had been scheduled for late October, but at the last moment was pushed back so that the jet's rudder pedals could be changed. Prior to this, the ambitious programme had suffered a number of delays. Mitsubishi plans to have five aircraft in its test fleet. A large part of the testing work will be undertaken in the USA, starting from the second quarter of 2016.



Mitsubishi Aircraft



Comac

C919 rolls out

Chinese national pride was boosted on 4 November, when Comac rolled out its long-awaited C919; a narrowbody jet aimed squarely at the market served by Boeing's 737 and Airbus's A320.

Despite being China's first effort at producing a truly competitive airliner, the aircraft already has more than 500 orders, mainly from Chinese airlines and leasing companies.

Flightglobal, which visited the unfinished fuselage in Shanghai in April, was impressed by the apparent speed with which Comac was able to install the engines, landing gear, and other key systems. That said, journalists were not allowed to peek inside the finished aircraft at the early November event. Comac has a long way to go before it rivals the likes of Boeing and Airbus, but the C919's roll-out is a clear sign that the Boeing/Airbus duopoly cannot last forever.

Aerospace gets a geography lesson

In 2015, Airbus started building A320s in Alabama and Boeing announced plans to deliver 737s from an unspecified location in China.

The present narrowbody order boom has produced a lot of previously unthinkable moves, such as a global supply chain ramping up to build as many as 120 A320s and 737s combined each month by the end of the decade.

But none are likely to be more enduring than the evolving geography of narrowbody final assembly and delivery centres.

To be sure, most aspects of the Airbus and Boeing production systems won't change. Airbus will still concentrate major component assembly work in Europe and distribute final assembly to two centres in Europe, one in China and the newly-opened final assembly line in Mobile, Alabama. Boeing, meanwhile, will still be oriented in the opposite direction, with major component work distributed over a vast supply chain and final assembly concentrated in the Puget Sound area and, in the singular case of the 787 programme, also North Charleston, South Carolina.

But there has been a change of direction in the

past year. Never before has Boeing delivered aircraft from outside the USA and never before has Airbus assembled and delivered commercial airliners from within it.

As that changes, both manufacturers will be creating what they need the most: extra capacity. Opening a fourth production line in the USA is vital to Airbus's plans to continue expanding A320 production rates. Likewise, Boeing needs room to

grow, and opening a 737 delivery centre in China is a sensible first step in that direction.

Both manufacturers are also following the market's lead. According to their own forecasts, the USA will remain the largest air transport market for most of the next 20 years. China represents the fastest growing market over that period, eventually over-taking the USA as the world's largest consumer of new airliners.



Airbus

At Textron, it's bigger, bolder and fresher

Textron Aviation revealed a new direction with the unveiling of two Cessna Citation business jets – one new and one re-imagined – to sit at the top of the venerable airframer's 18-strong family of piston, turboprop and jet aircraft.

The new designs are positioned in two of the most crowded, yet lucrative sectors of the business aviation market, where Textron is aggressively seeking to expand.

The all-new Hemisphere is to be Cessna's flagship. It will compete in the large-cabin niche, which has proved a consistently strong performer throughout the economic downturn.

The Hemisphere will be Cessna's largest and longest-legged business jet to date, with a range of 4,500nm (8,320km) and a 2.59m (8.5ft) fuselage cross-section. It also has several advanced technologies for Cessna, including an at least partially fly-by-wire flight control system.

When it enters service early in the next decade, the \$30-35 million Hemisphere will be a shot across the bows of competitors Bombardier, Dassault and Embraer, whose large-cabin offerings – the Challenger 650, Falcon 2000LXS and Legacy 650 – are based on much older and narrower platforms.



The Hemisphere occupies the market segment originally envisioned for the Longitude. This clean-sheet aircraft was first mooted in 2012, but a strategy re-think following Cessna's takeover by Textron has initiated a revamp.

The recent model – unveiled at November's NBAA business aviation industry showcase and pictured here – is now positioned in the super-midsize sector between the midsize, high-speed Citation X+ and the Hemisphere.

Textron has reduced the original design's top range limit by 600nm to 3,400nm and has replaced its Snecma Silvercrest engines with Honeywell's HTF7700L.

First flight is on track for mid-2016 and deliveries should begin in the second half of 2017.

Cessna also quietly revealed plans for a new single-engined turboprop in July, but enthusiasts will have to wait until mid-2016 to see what shape and form this fresh design will take.



Boeing flies the KC-46A

Boeing's overthrow of Northrop Grumman and EADS to secure the US Air Force's next-generation tanker programme has threatened to become a poisoned chalice after a string of avoidable and expensive setbacks.

But the company's first KC-46A Pegasus took flight on 25 September, lifting the tanker team's spirits after an almost nine-month delay and nearly \$1.5 billion in Boeing-absorbed cost overruns.

Air force officials say Boeing is clocking up flight hours and burning through test points faster than expected, and the initial 767-2C test aircraft, that first flew in December 2014, is progressing steadily through US Federal Aviation Administration certification. Officials, though, caution to expect new discoveries as the programme continues. In spite of setbacks, Boeing has pledged to deliver 18 operational tankers by August 2017.

Is Boeing being blindly optimistic, or can it make up for lost time? That depends on how the KC-46A performs in 2016, with a "Milestone C" low-rate production review expected in the second quarter.

Airbus ticks off milestones

For Airbus, 2015 was a year nicely bookended by new model milestones. On 15 January, the A350 widebody entered service, when Qatar Airways flew its -900 from Doha to Frankfurt, having taken delivery of the Rolls-Royce Trent XWB-powered aircraft (A7-ALA), one of 80 A350s the carrier then had on order, on 22 December 2014.

And, the re-engined A320neo (pictured) won European and US type certification on 24 November. Clearance to commence deliveries of the Pratt & Whitney PW1100G version came a week shy of the fifth anniversary of the A320neo's launch, in December 2010. Early headway had led Airbus to pull its first delivery target back from the original 2016 target to October 2015, but engine testing snags cost it that deadline.



◆ F-35B ready for action with the US Marines



US Marine Corp

America's most expensive defence acquisition passed a major milestone on 31 July, with the US Marine Corps establishing its first combat-coded F-35B squadron.

The Marines say their stealthy Lockheed Martin-built combat jet is ready for prime time, after more than 14 years and billions of dollars of development. The multinational F-35 procurement has been beset by engineering faults, delays, cost overruns, and a worrying engine failure in 2014, but advocates say the initial operational capability declaration marks a turning point with all eyes now on preparations for the first US Air Force F-35A and US Navy F-35C squadrons. With approximately 25% of the test phase remaining and production scaling up, others caution the F-35 isn't out of the woods and programme participants face huge bills to bring aircraft up to the final Block 3F standard.

The "Green Knights" marine fighter-attack squadron will move to Japan in 2017, but the aircraft could be in battle sooner. Lockheed will be hoping the aircraft proves as lethal as it is costly.

◆ Northrop wins bomber deal

Speculation over who would build America's next stealth bomber ended on 27 October, when US Air Force secretary Deborah Lee James announced Northrop Grumman as winner of the Long-Range Strike Bomber (LRS-B) competition, at the expense of a Boeing/Lockheed Martin team.

As expected, the losing side's lawyers quickly sprang into action to find fault with the air force's source selection process and the Northrop win is now the subject of a US Government Accountability Office review, with a decision due by 16 February 2016.

The contract was a strategic victory for B-2 (pictured) creator Northrop, which had been running multi-million dollar advertising campaigns touting its bomber experience leading up to the decision – even securing a 2015 Super Bowl halftime spot.

If the selection holds up to scrutiny, LRS-B becomes Northrop's biggest project, dwarfing its next biggest aircraft programmes – the E-2D Advanced Hawkeye and MQ-4C Triton.

The USAF wants to keep the classified bomber hidden from potential rivals Russia and China as long as possible, but how long can you keep an \$80 billion programme secret from American taxpayers?



US Air Force



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◆ Electrics show the future

In July, Airbus claimed an interesting first, for a battery-powered crossing of the English Channel, when its e-Fan demonstrator with Didier Esteyne (pictured) at the controls hopped from Lydd, in England, to Calais in 37min. The flight – trailed as following in the slipstream of Bleriot – made headlines as far afield as the USA and Australia, but was far more than a barnstorming publicity stunt; Airbus is driving toward commercial production.

Paris air show visitors saw a mock-up of the production version; a stylish two-seat trainer that should make its first flight in late 2016 or early 2017. And, a four-seater with a kerosene engine "range extender" to keep the batteries topped up will follow.

Ultimately, Airbus has its sights on a 70- to 80-seat regional transport with hybrid electric power. Such a machine, says Airbus, is feasible – and could beat the noise restrictions that currently limit operations at secondary airports to daytime take-offs and landings.

SpaceX failure dents Musk

Launching rockets is no mean feat, so it came as no surprise that SpaceX finally lost one, when a Falcon 9 hefting an uncrewed Dragon cargo capsule to the International Space Station came to grief over the Atlantic some 139s after lift-off from Cape Canaveral on 29 June.

Structural failure of a strut supporting a second-stage helium tank was cited, the rocket disassembling rapidly rather than exploding. SpaceX boss Elon Musk promised to scour the other 18 missions-worth of F9 flight data for “near misses”, and insisted the disaster wouldn’t derail the 2017 timetable for the crewed version of Dragon – since the 2011 retirement of the Space Shuttle fleet, NASA’s only ride to space has been on Russian Soyuz rockets. Apart from leaving space station astronauts light on supplies (two other recent ISS resupply missions had ended badly), the failure took some shine off the SpaceX star. Musk – the Silicon Valley billionaire behind Tesla electric cars, inspiration for the Iron Man films’ Tony Stark character and partner of Hollywood star Talulah Riley (pictured with Musk) – has revolutionised

launch market pricing. By combining private sector cost discipline with the advantages of a clean-sheet programme, he forced his way into a market dominated by United Launch Alliance and Arianespace, and sent them back to the drawing board.

Musk had created an aura of invincibility. Now, customers, politicians and a space-loving American public may finally replace breathless excitement with rational expectations.



US Army

Lockheed acquires Sikorsky

Increasingly the odd-man-out at United Technologies (UTC), helicopter maker Sikorsky started the year in a state of uncertainty. Its parent company had indicated it was exploring options for the maker of the UH-60 Black Hawk (pictured), but was not committed to a sale. As the year went on, divestment expectations rose, culminating in a “for sale” announcement at the Paris air show in June. After a short bidding process Lockheed Martin emerged victorious. It is paying \$9 billion for Sikorsky, in a deal which represents a massive diversification of Lockheed’s military aircraft portfolio, dominated by the \$400 billion F-35 Joint Strike Fighter programme. At a stroke, it gains a 65% share of the US military rotorcraft business, mostly through the Black Hawk and derivatives, plus the CH-53K King Stallion for the US Marine Corps. For the end-user it consolidates major US defence programmes under one roof, with Lockheed in charge of the US Air Force’s HH-60W combat rescue helicopter project and a partner in both teams bidding for the army’s joint multirole technology demonstrator.



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Embraer completes its Legacy lineup

Embraer’s ambitious 10-year business aircraft development effort reached its climax in August, when the seventh and final programme, the Legacy 450 (pictured), secured US certification. The first aircraft is being readied for delivery to its US customer during December 2015.

The Brazilian airframer launched its Executive Jets division in May 2005 with a quest to become a powerhouse in the business aviation market.

It hasn’t disappointed, with a sector-busting range that includes the Phenom 100 and 300 as its entry level offerings, the Legacy 500 and 600 in the middle, the large-cabin Legacy 650 and the Lineage 1000E VIP airliner at the helm.

To date nearly 1,000 business jets have been delivered worldwide.

The Legacy 450 fills a critical gap, combining super-light size with performance usually associated with larger, midsize jets. In the face of growing competition from Cessna’s new Citation Latitude, which was certificated around the same time, Embraer then went further, announcing in



Embraer

November a 10% increase in the twinjet’s range, to 2,900nm (5,370km). The extra mileage gives the Legacy 450 a 400nm advantage over the Latitude and will enable the aircraft to connect

many more city pairs non-stop, such as San Francisco to Hawaii and Abu Dhabi to Cannes. It is slated to enter service as the baseline model in the third quarter of 2016.

Bomb downs MetroJet A321

A fresh reminder, if any were needed, of aviation's vulnerability to terrorism was served up on 31 October, when an Airbus A321 operated by Russia's MetroJet crashed in the Sinai after take-off from Egypt's Sharm el-Sheikh international airport. Russian investigators determined the aircraft was brought down by a bomb. The investigators, finding traces of explosives in baggage and debris, concluded that a blast equivalent to about 1kg (2.2lb) of TNT destroyed the aircraft, killing all 224 occupants.

Islamic extremist group ISIS was squarely implicated.



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AirTeamImages

Transaero: down and out

Economic woes in Russia didn't spare aviation. The biggest casualty was Transaero – once the poster child for an airline industry that had shed its grim Soviet clothes for modern (read, "Western") jets and smiling cabin crew but, by the latter half of 2015, was teetering on the edge of bankruptcy.

In 2014, the airline made a net loss of Rb19.3 billion (around \$290 million at summer 2015 exchange rates), and in the first seven months of 2015 it paid close to a sixth of revenue to creditor banks.

Collapse came in October, when the carrier was grounded by Russian regulator Rosaviatsia, concerned about its "unsatisfactory financial and economic condition" and arrears to Russian air navigation providers of around Rb1 billion (\$15 million).

Flag carrier Aeroflot declined a chance to take a stake, but picked up some of the pieces – taking on many of Transaero's routes, aircraft and staff.

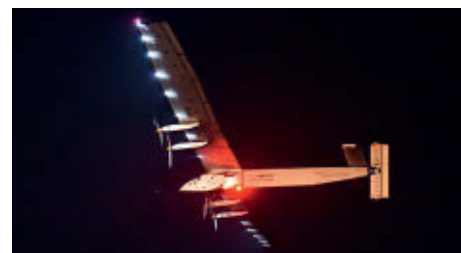
Epic Impulse shows power of technology

In a year ending with a landmark inter-governmental climate change conference in Paris, make special note of Solar Impulse. After 12 years of preparations, the Switzerland-based operation got off the ground in Abu Dhabi in March to kick off a 12-stage, 35,000km round-the-world flight – on nothing but solar power.

Solar Impulse is a remarkable achievement from an aviation perspective: the single-seat sec-

ond-iteration aircraft has a wingspan of 72m (a Boeing 747-8I comes in at "just" 68.5m), but weighs a mere 2,300kg (5,071lb) – about the mass of a car – including its 633kg load of lithium batteries and the 17,248 solar cells on its horizontal surfaces.

Co-founders André Borschberg and Bertrand Piccard – accomplished aviators – repeatedly stress the project is not about aviation: it is about



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energy. The pair hope flying huge distances with no more power than is generated by a small motor scooter will demonstrate the world's formidable energy challenges can be met by existing technologies. As Piccard puts it: "With our attempt to complete the first solar-powered round-the-world flight, we want to demonstrate clean tech and renewable energy can achieve the impossible."

En route, Solar Impulse 2 smashed all solar-powered crewed flight endurance records on an epic five-day/five-night leg from Nagoya to Hawaii. Alas, the effort overcooked its batteries and the machine is grounded for repairs – and a redesigned battery system – until Spring 2016.



European Space Agency

Space Station star stays long

One beneficiary, if it's alright to put it quite that way, of a string of failed resupply missions to the International Space Station was Italy's Samantha Cristoforetti. Due to plummet home in mid-May after six months on board, the failure of a late-April uncrewed Russian supply ship prompted caution and the return date was pushed back a by month – keeping her in space for just a few hours shy of 200 days; the record for a woman and for any European Space Agency astronaut.

The Italian air force captain made good use of her time in orbit: two space walks and a hugely active media presence, with video reports on everything from special meals prepared for the mission to how space station crew wash their hair and flush the toilet. A real star – evidence her Twitter following of 430,000.

Station crews to come will always thank Cristoforetti and the Italian space agency for arguably the most important improvement to ISS amenities in the 15-year history of the orbiting laboratory. Before her departure, @AstroSamantha was able to unpack and commission into service a microwave oven-sized “ISSpresso” machine built specially by Lavazza in Italy, with space food specialists Argotec. Given the high pressures and temperatures required, making an espresso is no mean feat in microgravity – and anyone who has tasted astronauts' coffee-in-a-tube will appreciate the realisation of what could well be the key enabling technology for any long-duration mission to, say, Mars.



NASA/SIPA/Rex Shutterstock

Rocket recycling, step 1

Another Silicon Valley mogul turned rocketman, Jeff Bezos of Amazon, notched a notable success in November, when his space company, Blue Origin, launched its BE-3 rocket to suborbital space and recovered the notionally reusable vehicle in a rocket-powered vertical landing, from West Texas.

The second BE-3 flight, to 100.5km, followed a maiden sortie which failed to save the booster. Both saw the New Shepard payload capsule safely returned by parachute. The plan is to offer short flights for fare-paying passengers or scientific payloads. Bezos's ambitions go beyond suborbital spaceflight. A bigger rocket engine, BE-4, is being developed with United Launch Alliance as a stage in its modular Vulcan system, to replace the Boeing-Lockheed Martin joint venture's Atlas V and Delta IV rockets. As the company puts it: “We are building Blue Origin to seed an enduring human presence in space; to help us move beyond this blue planet that is the origin of all we know. We are pursuing this vision patiently, step-by-step.”



ZUMA Wire/Rex Shutterstock

US rocketry gets a boost

Orbital Sciences and ATK planned to have merged by the end of 2014, but the spectacular October 2014 launchpad explosion of a space station-bound Orbital Antares rocket and Orbital Cygnus resupply ship pushed completion into January. No matter, the tie-up makes sense; ATK makes solid rocket motors, satellite systems and composite structures while, as well as Antares and Cygnus, Orbital makes satellites and small launch systems.

The creation of Orbital ATK is just one sign that American rocketry is entering a new golden age. With the private sector shake-up kicked off by SpaceX and the sanctions tit-for-tat over Ukraine and Crimea, time has been called

on the days of US rockets like Antares and United Launch Alliance's Atlas V (pictured) being built around Russian engines.

The US Air Force, heavily reliant on Atlas V for national security launches, may even call for an all-new, all-American launch system. Meanwhile, United Launch Alliance has kicked off development of a modular system, called Vulcan, that will eventually replace Atlas V and Delta IV.



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UNCLE ROGER'S FESTIVE QUIZ

In the way of year-end rituals, there are some things you just can't escape. Stuff like fixing the roof after a hard sleigh landing, getting punched in the face over a big-screen TV at WalMart on Black Friday and hearing Noddy Holder sing often enough to think, "Well, here it is. Again." But in *Flight International* Land, we all know the true secret to goodwill, joy, bonhomie and even a sprinkle of spriritual enlightenment: Uncle Roger's Festive Quiz. You know the drill – multiple choice and photo identification, answers on page 44. Or, test your aviation knowledge online at flightglobal.com/quiz15

Answers on page 44



Max Kingsley-Jones/Flightglobal



Max Kingsley-Jones/Flightglobal



Flightglobal

AIR TRANSPORT

1. In 2015, which Asia-Pacific airline was announced as the launch carrier of the Airbus A350-900ULR?

- a. All Nippon Airways
- b. Japan Airlines
- c. Singapore Airlines
- d. Cathay Pacific

2. At which air shows in 2015 did the Bombardier CSeries make a debut appearance?

- a. India and Paris
- b. Paris and Dubai
- c. Paris and MAKS
- d. Oshkosh and NBAA

3. Which low-cost carrier celebrated its 30th birthday in 2015?

- a. Cebu Pacific
- b. EasyJet
- c. Ryanair
- d. Southwest

4. To which German city did Qatar Airways inaugurate A350 services in January 2015?

- a. Berlin
- b. Munich
- c. Frankfurt
- d. Dusseldorf

5. Which flag carrier has undertaken six CEO changes since 2012?

- a. Alitalia
- b. South African Airways
- c. LOT
- d. Thai Airways

6. Emirates has launched a high-density two-class Airbus A380 configuration – with how many seats?

- a. 597
- b. 645
- c. 615
- d. 723

7. Which airline executive marked Back to the Future day with an appearance in his home city to speak at a press conference held by the flag carrier he led a decade previously?

- a. Christoph Mueller
- b. Willie Walsh
- c. Carsten Spohr
- d. Richard Anderson

8. Which airline currently operates the longest air route?

- a. Emirates
- b. Qantas
- c. China Airlines
- d. Singapore Airlines

9. Which airline has split its Airbus A320neo family orders between Pratt & Whitney and CFM International?

- a. Lufthansa
- b. IAG
- c. Etihad Airways
- d. Malaysia Airlines



ExecuJet



Max Kingsley-Jones/Flightglobal

DEFENCE

10. South Korea's proposed KFX fighter had a major setback when the country failed to obtain US export licences for four core technologies. Which technology is NOT one of the four?

- a. Active electronically scanned array radar
- b. Stealth
- c. Infrared search and track
- d. Electro-optical targeting

11. Which Asia-Pacific nation may buy former US Navy Lockheed S-3B Viking aircraft for anti-submarine warfare?

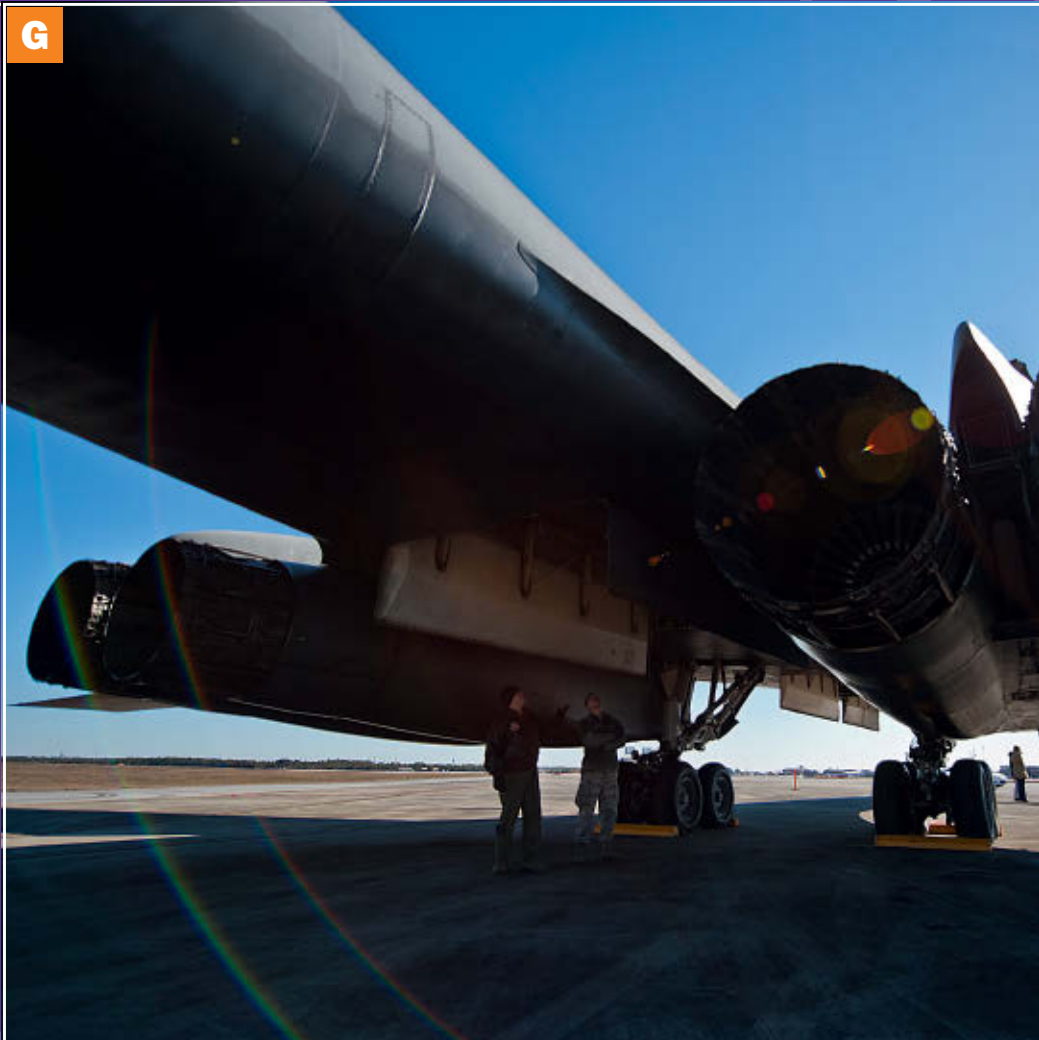
- a. Japan
- b. South Korea
- c. The Philippines
- d. Thailand

12. Which JSTARS Recap hopeful missed out on one of three US Air Force risk-reduction contracts?

- a. Boeing
- b. Lockheed Martin
- c. Northrop Grumman
- d. Sierra Nevada/Intuitive

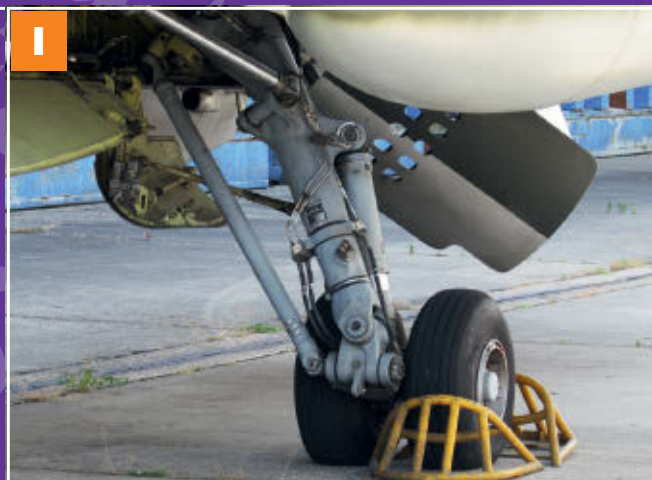
13. Which export customer will be the first to introduce General Atomics Aeronautical Systems' unmanned Predator XP?

- a. Canada
- b. Kazakhstan
- c. Saudi Arabia
- d. The United Arab Emirates





US Air Force



Max Kingsley-Jones/Flightglobal



Max Kingsley-Jones/Flightglobal

14. If Canada's new government scraps its plan to buy 65 Lockheed Martin F-35s, how much more money will each F-35 cost, according to the US government?

- a. \$1 million
- b. +15%
- c. \$85 million
- d. It won't change unit costs

15. Which one of these nations did not make a fresh commitment to the Dassault Rafale during 2015?

- a. Egypt
- b. India
- c. Kuwait
- d. Qatar

16. Embraer's KC-390 made its first flight in February 2015. How many does Brazil plan to buy?

- a. 10
- b. 28
- c. 50
- d. 390

BUSINESS AVIATION

17. What is the name of Cessna's all-new large-cabin business jet?

- a. M2
- b. Columbus
- c. Latitude
- d. Hemisphere



Rex Shutterstock

FESTIVE QUIZ

18. Which Embraer business jet is to get a range boost in 2016?

- a. Legacy 500
- b. Lineage 1000E
- c. Legacy 450
- d. Phenom 300E

19. Which widebody Falcon had its public unveiling in June 2015?

- a. 8X
- b. 5X
- c. 10X
- d. 7X

20. Which piston-engined aircraft manufacturer still has a jet-powered model in its sights?

- a. Diamond Aircraft
- b. Piper Aircraft
- c. Tecnam
- d. Flight Design

21. Which US operator gave the Aerion AS2 supersonic business jet programme a critical boost with an order for 20 aircraft?

- a. NetJets
- b. VistaJet
- c. Flexjet
- d. PlaneSense

22. What is the longest-range traditional business jet in production?

- a. Gulfstream G650ER
- b. Falcon 7X
- c. Global 6000
- d. Boeing Business Jet

23. What is the longest-range traditional business jet in development?

- a. Hemisphere
- b. Falcon 8X
- c. Global 7000
- d. Global 8000



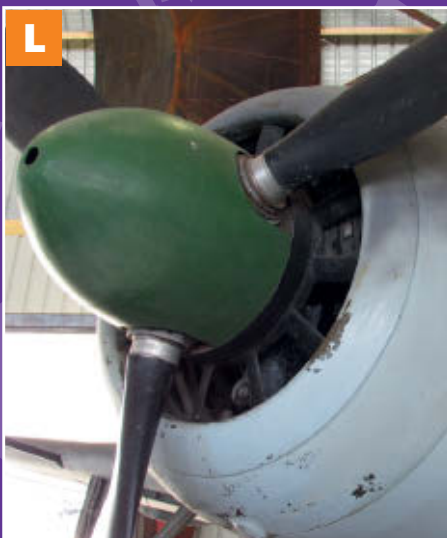
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Max Kingsley-Jones/Flightglobal



Max Kingsley-Jones/Flightglobal



Max Kingsley-Jones/Flightglobal



US Navy

Q



Max Kingsley-Jones/Flightglobal

ROTORCRAFT

24. Under Airbus Helicopters' new naming convention, what has the AS350 Squirrel become?

- a. H100
- b. H125
- c. H350
- d. H365

25. Which of the following is not a Westland product?

- a. Wasp
- b. Waikiki
- c. Widgeon
- d. Weasel

26. Bell Helicopter's 505 is unique because?

- a. It is the firm's first light single
- b. It has a composite fuselage
- c. It uses a Turbomeca engine
- d. It has a glass cockpit

27. Airbus Helicopters' Bluecopter demonstrator features a cartoon of what on its side?

- a. A bat
- b. A snake
- c. A witch
- d. An eagle

HISTORY

28. In December 1945, what was the first jet to land and take-off from an aircraft carrier?

- a. Hawker Sea Hawk
- b. Supermarine Attacker
- c. McDonnell Banshee
- d. de Havilland Sea Vampire

R



Max Kingsley-Jones/Flightglobal

S



Rob Morris/Flightglobal

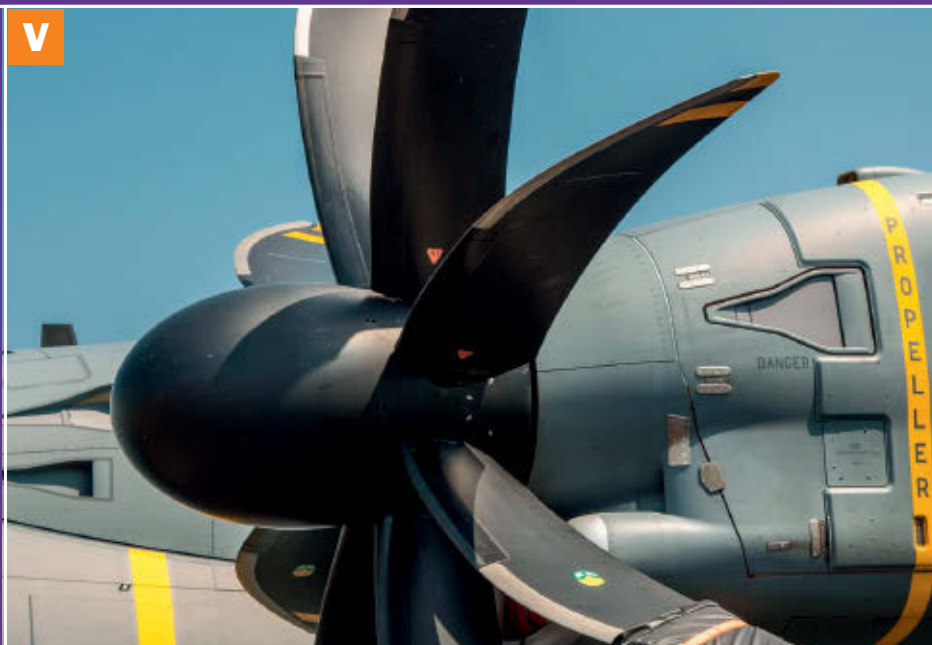
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Max Kingsley-Jones/Flightglobal



Max Kingsley-Jones/Flightglobal



Rex Shutterstock

29. Which engine powered the BAC One-Eleven and the Blackburn Buccaneer (S2)?

- a. R-R Spey
- b. Bristol Siddeley Olympus
- c. de Havilland Ghost
- d. R-R Avon

30. Which Latin American carrier was the first to operate jet airliners, and what was the type?

- a. Varig with Boeing 707s
- b. Avianca with Boeing 720s
- c. Viasa with Douglas DC-8s
- d. Aerolineas Argentinas with de Havilland Comet 4s

31. How many engines did the Hawker Siddeley Trident 3B have?

- a. Two
- b. Three
- c. Four
- d. Five

INDUSTRY AND TECHNOLOGY

32. Which UK manufacturer celebrated 100 years of aircraft production in 2015?

- a. BAE Systems
- b. Britten Norman
- c. Slingsby Aviation
- d. Westland

33. Which fuselage shape did a Merrill Lynch analyst say Boeing was considering for a possible new airliner aimed at replacing the 757 and 767-200?

- a. Circle
- b. Blended wing body
- c. Double-bubble
- d. Elliptical

34. Which southern US town hosted a grand opening for Airbus's fourth final assembly line for the A320 in September 2015?

- a. Muscle Shoals, Mississippi
- b. Athens, Georgia
- c. Mobile, Alabama
- d. Memphis, Tennessee



Max Kingsley-Jones/Flightglobal



Max Kingsley-Jones/Flightglobal

35. What aerodynamic innovation, that made its debut on the 787-9, did Boeing decide to delete from the 777X?

- a. Fly-by-wire spoilers
- b. Electric-powered ground taxi
- c. Folding wingtips
- d. Hybrid laminar flow control

36. In which Chinese city does Comac produce the ARJ21 and C919?

- a. Tianjin
- b. Xian
- c. Shanghai
- d. Shenyang

37. Pratt & Whitney expects the geared turbofan engine fleet to stream how much data in real time to ground-based servers every year by 2030?

- a. 12 petabytes
- b. 12 gigabytes
- c. 12 terabytes
- d. 12 wonkabytes

SPACEFLIGHT

38. United Launch Alliance unveiled a new launcher concept that will eventually replace Atlas V and Delta IV. What's it called?

- a. Ares
- b. Vulcan
- c. Neptune
- d. Capricorn

39. Which company is prime contractor for the European Space Agency's Ariane 6 rocket programme?

- a. Thales Alenia Space
- b. Arianespace
- c. Airbus Safran Launchers
- d. ELV SpA

40. Name the Silicon Valley billionaire behind rocket developer Blue Origin.

- a. Elon Musk
- b. Paul Allen
- c. Mark Zuckerberg
- d. Jeff Bezos



Max Kingsley-Jones/Flightglobal



Greg Walton/Flightglobal



Max Kingsley-Jones/Flightglobal



Max Kingsley-Jones/Flightglobal

41. While Virgin Galactic's suborbital tourism programme struggles, it is making steady progress with its LauncherOne satellite launch project, developing air-launched rockets named after which scientist?

- a. Newton
- b. Kepler
- c. Van Allen
- d. Goddard

42. Europe's Ariane 5 rocket programme finishes 2015 with a string of how many successful launches?

- a. 65
- b. 69
- c. 70
- d. 72

Answers on page 44



Max Kingsley-Jones/Flightglobal



Gordon Rayfield

THE ART OF NOISE

Thirty years ago, environmental legislation banished the Hawker Siddeley Trident from Europe's skies. But the tri-jet is remembered for more than just making a loud din



MAX KINGSLEY-JONES LONDON

The introduction of ICAO Annex 16 Chapter 2 noise legislation on 1 January 1986 forced operators of older first- and second-generation jets to hush kit their fleets. For British Airways, this was not a viable option for its Hawker Siddeley HS 121 Tridents – not that it needed an excuse to phase out these fuel-thirsty geriatric jets.

The Trident's engine configuration – and marginal low-speed performance – meant installing “dustbin-style” hush kits on its three Rolls-Royce Spey turbofans was impractical. BA was the sole operator in Europe – the only other Trident stalwart was CAAC in China, which did not adopt the legislation at that point. So as the era of new noise rules loomed, the UK carrier ceased flying the tri-jet – dubbed the “Gripper” by pilots due to its cumbersome, ground-hugging take-offs – on the evening of 31 December 1985.

By that time, the airline's Trident replacement programme was into its stride. BA and predecessor BEA had operated more than 70 Trident 1C/1Es, 2Es and 3Bs and began replacing the type in the early 1980s with Boeing narrowbodies – 737-200s and 757-200s.

LAST SERVICES

By December 1985, BA's Trident fleet had dwindled to six 3Bs while its 737s and 757s numbered 36 and 20 aircraft, respectively. On 31 December, BA operated the type's final passenger flights from London Heathrow – a round trip to Copenhagen (in recognition of its first service, in March 1964), a return “Shuttle” flight to Manchester (marking another significant contribution the Trident made to the BA network) and a return charter to Amsterdam.

This writer was on board that final international passenger flight from Schiphol on New Year's Eve, which air traffic control co-ordinated to approach Heathrow's parallel runways

simultaneously with the inbound Manchester service – a fitting way to bring the era of the British tri-jet to a close.

By the time of its retirement, the Trident was recognised mostly for the noise and smoke generated on take-off. But crews who flew the de Havilland-designed jet in its heyday recall a true pilots' aircraft with “crisp” and “fighter-like” flying qualities. The aircraft's arrival into service in 1964 delivered a step-change in automation and set a benchmark for low-visibility operations that remains valid today.

After a maiden flight on 9 January 1962 from the old de Havilland plant at Hatfield, the Trident's handling was refined by famed test pilot and Second World War legend John Cunningham. “It was an awesome machine to fly,” recalls former BEA and British Airways Trident pilot Capt John Rankin. “It was the best handling airliner I ever flew, with superb control, agility and rock solid stability, roll rates of 30° a second and smooth as silk right up to its

Mach 0.96 maximum speed. The Boeings I've flown since felt like the designer drove a Cadillac. The Trident felt like a finely tuned sports car."

FAST SHIP

Accompanying Cunningham in the six-man crew on that first flight was young test engineer John Johnston, who later became assistant flight-test manager for the Trident. He recalls that while the Trident "was not a sparkling performer on the ground, the high Mach number behaviour was fantastic. We never did reach the limit in testing.

"We got to Mach 0.975 during the Trident 1's high-speed test, but this was not the maximum. There was no buffet."

A key component of the Trident's development was its "Autoland" system pioneered by Smiths Industries – now part of GE Aviation. This would ultimately allow operations in almost zero visibility.

Central to this was the SEP.5 autopilot, which enabled an impressive amount of autoflight capability by 1960s standards.

Former Trident pilot Chris Wood believes that the aircraft was so advanced for its era that it was on a par even with today's latest fly-by-wire Airbus in terms of flightdeck systems. "We had an excellent autopilot and Category IIIB Autoland, good instrumentation and even a moving-map display.

"You could see two black marks on Heathrow's 28L runway where all the Tridents had

touched down in exactly the same place under Smiths autopilot control!"

On 10 June 1965, a BEA Trident 1C made the world's first automated landing on a commercial service at Heathrow, arriving from Paris with 10 passengers. BEA, and then BA, was progressively cleared to operate automatic landings in increasingly reduced weather minima until the ultimate goal of Category IIIB, with a 12ft decision height/75m runway visual range approved in 1975.

By the 1970s, BA's Trident fleet was regularly operating into Heathrow in thick fog when the rest of Europe's airlines were grounded, waiting in the vain hope that the sun would break through. The airline made much of its Trident fleet's capability, boasting that it was "number one in Europe" in its advertising campaigns.

Along with noise and technical innovation, another aspect of the Trident's legacy was its association with the then-new phenomenon of the "deep stall", which can afflict aircraft with T-tail configurations. Such designs tend not to exhibit the classic nose-drop when entering the stall, but rather pitch up steeply and eventually enter a deep stall from which recovery can prove impossible.

The issue came to light during flight-testing, which had to be extended to investigate the phenomenon. "We tried all sorts of things – we did 2,000 stalls before we thought about installing a 'stick-pusher', and that was only after Vickers' windtunnel tests showed that the



Kevin Bowen's collection devoted to the Gripper

high-tail configuration was prone to this deep-stall problem," says former test engineer Johnston. "We would never have got it certificated without the stick-pusher."

DEEP STALL

While the test programme established a certification path around the deep stall, the susceptibility would cause the loss of two BEA Tridents – one in June 1966 during flight-testing (killing six crew) and the other on take-off from Heathrow, in which 118 people died.

That 1972 "Papa India" accident near the town of Staines remains a sensitive subject for ex-Trident pilots. The accident was blamed on the crew for inadvertently raising the droop high-lift device at a dangerously low speed, but pilots feel it was an accident waiting to happen. "We had two 'dress-rehearsals' before Papa India where somehow the aircraft was saved, but no modification was made to prevent the early retraction," says a former BEA Trident pilot. "After Papa India, we got a speed lock on the lever to prevent early retraction."

Hawker Siddeley built just 117 Tridents and few aviation historians deny the groundwork de Havilland laid with its 121st design should have been the springboard for global success. In its original guise the DH121, as it was known, was hugely influential on the design of Boeing's first attempt at a short-haul jet – the similar-looking 727. But while de Havilland caved to pressure from launch customer BEA amid a drop in passenger growth forecasts and shrunk its design, Boeing built the 727 tri-jet as the aircraft the DH121 should have been, and sold 1,831 of them.

The other major Trident operator was CAAC, which took 35. The last and 116th delivery took place in September 1978, to CAAC. Chinese Trident operations continued into the 1990s, when the sun finally set on the tri-jet.

The Trident era may have ended in Europe three decades ago, but the type is in evidence at UK museums. Duxford, Manchester, Wroughton and Sunderland's North East Aircraft museum have complete examples. And if it's full-on 1960s BEA nostalgia you like, pay a visit to Trident enthusiast Kevin Bowen's Heathrow Trident Collection on the outskirts of the Gripper's old stomping ground (visits can be arranged by emailing g-awzk@msn.com). ■



The three-engine configuration of the Trident (right) inspired Boeing's 727, which went on to enjoy huge demand



Busy flightdeck was bristling with technology



War hero Cunningham refined handling

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Time to resurrect RAF squadrons?

Following the release of the second Strategic Defence and Security Review by the UK government on 23 November, I note with interest that the Royal Air Force will be forming two more Typhoon squadrons.

With 1, 2, 3, 6, 11 and 41 Sqn already operating the type, maybe it is time for some of the traditional RAF fighter squadrons to resurface.

Following some research, two candidates come to mind with proven combat records, both in First and the Second World Wars, and should qualify for consideration to be selected for Typhoon operations.

The first is 56 Sqn (The Firebirds), which was formed at Gosport in June 1916 equipped with Royal Aircraft Factory SE.5As. In the inter-war period it flew Sopwith Snipes, and was the third unit to equip with Hawker Hurricanes covering the Dunkirk beaches and then served in the Battle of Britain. What is most significant was 56 Sqn was the first to be equipped with the Typhoon



Airbus Defence & Space

The Atlas is unable to fulfil some in-flight refuelling requirements

ACQUISITION

A400M not fit to refuel Caracal

The news that France needs to buy some Lockheed Martin Hercules to refuel its Airbus Helicopters H225M Caracal rotorcraft (*Flight International*, 24-30 November) cannot pass without comment.

The move comes as a result of the last of several performance shortfalls of the A400M, which has proved unable to cover this role. The programme is known for being late, the machine is not cheap and it is still far from yielding what was initially agreed with Airbus Defence & Space.

The money of British, German, French and Spanish taxpayers could have been spent in a better way.

Giorgio Dainese

Munich, Germany

Ia on 11 September 1941, later replacing them with Tempests. Post-war, it entered the jet age with Gloster Meteors, Hawker Hunters, Supermarine Swifts and English Electric Lightnings.

Another candidate is 74 Sqn (The Tigers), which also served in both world wars having been formed at Northolt on 1 July 1917. In the 1930s the squadron flew Hawker Demons from Malta, but was equipped with Spitfires at Hornchurch from February 1939, taking part in the Battle of Britain. Post-war, the squadron was equipped with Meteors, Hunters and Lightnings.

74 Sqn used to attend NATO

Tiger Meets, but since it disbanded, the RAF has been represented by 230 Sqn with Airbus Helicopters Puma HC2s – not quite in the spirit of the exercise.

If 74 Sqn is chosen for Typhoons, the RAF and NATO would benefit from joint exercises with Britain's premier attack aircraft, helping to promote foreign sales.

I do not know how squadrons are reformed, but pride and heritage play a strong part in overall morale, and seeing these squadrons back in operation must be good for the RAF and Britain.

Philip Birtles

Stevenage, Hertfordshire, UK

FESTIVE QUIZ ANSWERS

- | | | | |
|-------|-------|-------|-------|
| 1. c | 12. d | 23. d | 34. c |
| 2. b | 13. d | 24. b | 35. d |
| 3. c | 14. a | 25. b | 36. c |
| 4. c | 15. c | 26. c | 37. a |
| 5. b | 16. b | 27. c | 38. b |
| 6. c | 17. d | 28. d | 39. c |
| 7. b | 18. c | 29. a | 40. d |
| 8. b | 19. b | 30. d | 41. a |
| 9. a | 20. a | 31. d | 42. b |
| 10. b | 21. c | 32. d | |
| 11. b | 22. a | 33. d | |

PHOTOGRAPHS

- A. Pratt & Whitney PW1500G (Bombardier CSeries)
- B. Cessna 195
- C. Vickers VC10
- D. Gulfstreams (seven) and one Bombardier Global Express
- E. Boeing 757-200
- F. Bombardier CS100
- G. Boeing B-1B
- H. Ariane 5 Vulcain 2
- I. Sepecat Jaguar E
- J. Airbus A320-200
- K. Ivchenko-Progress D-18T (Antonov An-225 Mriya)
- L. Focke-Wulf Fw 190A
- M. General Electric GEnx (Boeing 787-9)
- N. Airbus A350-900
- O. Boeing 737-700 & Boeing 717-200
- P. Boeing F/A-18F Super Hornet
- Q. Boeing 777-300ER
- R. McDonnell Douglas DC-9-50
- S. Embraer E190
- T. Douglas DC-3
- U. Morane Saulnier MS 760 Paris
- V. Europrop TP400-D6 (Airbus A400M Atlas)
- W. Aérospatiale/BAC Concorde
- X. Dassault-Breguet Super Étendard
- Y. Lockheed Martin F-16D
- Z. Clockwise from top left; Boeing 767-200, Boeing CH-47D, Fokker 100 and Convair 880



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21-23 January 2016

Bahrain International Airshow
bahraininternationalairshow.com

3-4 February 2016

Aircraft Interiors Middle East
Dubai World Trade Centre, UAE
aime.aero/welcome-to-aime-2016

16-21 February 2016

Singapore Air Show
Changi Exhibition Centre, Singapore
singaporeairshow.com

17-19 February 2016

Routes Americas
Puerto Rico
routesonline.com/events/178/
routes-americas-2016

1-3 March 2016

Heli-Expo
Louisville, Kentucky, USA
heliexpo.rotor.org

6-8 March 2016

Routes Asia
Manila, Philippines
routesonline.com/events/180/
routes-asia-2016

8-9 March 2016

**Airline & Aerospace MRO & Operations
IT Conference - Americas**
Miami, USA
aircraft-commerce.com

15-17 March 2016

IATA World Cargo Symposium
Berlin, Germany
iata.org/events/wcs/pages/index.aspx

22-23 March 2016

Aerial Firefighting International
Sacramento, California, USA
tangentlink.com/event/aerial-
firefighting-international-2016

26 March - 3 April 2016

FIDAE
Santiago, Chile
fidae.cl/en

5-7 April 2016

Aircraft Interiors
Hamburg, Germany
aircraftinteriorsexpo.com

12-14 April 2016

ABACE
Shanghai, China
abace.aero

18-21 April 2016

Defence Services Asia
Kuala Lumpur, Malaysia
dsaexhibition.com

27-28 April 2016

Aircraft eEnablement & IFE Conference
London, UK
aircraft-commerce.com

2-5 May 2016

Xponential
New Orleans, USA
xponential.org

24-26 May 2016

EBACE
Geneva, Switzerland
ebace.aero

1-4 June 2016

ILA Berlin Air Show
Berlin, Germany
ila-berlin.com



For a full list of events see
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Air Traffic**

Birmingham Airport, the UK's 7th busiest Airport, is located 5.5 nm ESE of the City of Birmingham and alongside the National Exhibition Centre.

Birmingham Airport has recently taken the provision of Air Traffic Services in house. In accordance with Birmingham Airport Air Traffic Ltd (BAATL) ANSP Policy Statement 'to provide the highest level of safety in its air navigation services and whenever practicable improve the safety of those services' BAATL will be looking for a highly safety-focused individual who will maintain the current high standard of service delivery.

BAATL would therefore like to invite applications for the following post:

Manager Air Traffic Services –

The successful candidate will, as part of the air traffic management team, be accountable to the Head of Air Navigation Services for the provision of safe and expeditious ATC and Met services at Birmingham Airport.

They should hold a European ATCO Licence with currently validated ratings in ADI and APS. In addition, a Met Observers Certificate and OJT endorsement are also essential. An EXM endorsement is desirable.

Air Navigation Services are provided in accordance with all statutory/regulatory requirements and the BAATL Integrated Management System. A comprehensive knowledge of Safety, Quality and Security Management systems is essential. The successful candidate will have recent management experience within the ATC environment, in an administrative, operational or training role. A competitive remuneration & relocation package is on offer.

Suitably qualified candidates should submit a covering letter and CV to recruitment@birminghamairport.co.uk. Any queries should also be directed to this address.

The closing date for applications will be Monday 21st December 2015

Interviews will take place on
Tuesday 5th and Thursday 7th January 2016.

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- Maintain standards in line with our ATO and as and when required
- Supervise and maintain company standards of training
- Maintain a database of contract instructors, ensuring that all instructors are eligible and meet CAE's high standards
- Work closely with scheduling to ensure that all Instructors are scheduled for premium use of their time
- Manage, lead and develop a team of full time flight Instructors and Training Administrators through mentoring and proactive coaching
- To liaise with departmental heads and participate in review meetings

To be successful you should be able to demonstrate these skills and experience:

- Proven management experience in a similar role
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- Proficient at managing time, cost, quality and people objectives
- Great interpersonal and communication skills
- Excellent IT skills



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WORK EXPERIENCE LUIS GARCIA

Speaking the language of clients

A career spent working for Boeing has given former mechanical engineering graduate and service engineer Luis Garcia the experience to provide optimum customer service, with his language skills helping to bridge cultural divides

How did you start out?

I was born and raised in a small town in Ohio called Defiance. After high school, I studied engineering at Ohio State University and graduated with a degree in mechanical engineering. Boeing was actively recruiting engineers on campus, and after an orientation presentation from the company, I was sold on an exciting career in aviation. Boeing has given me the opportunity to work in many different roles.

Boeing's been your only employer?

Most of my career has been in customer service, which I have found to be the most rewarding. Early in my career, I worked in design, stress analysis and manufacturing. As a service engineer, I supported the structures organisation in landing gear, nacelles and wing and provided on-site engineering support to the aircraft on ground (AOG) recovery team on several repairs in Spain, Canada, Chile and China.

In 1998, I joined the field service organisation and have had short- and long-term assignments in Brazil, Ireland, Saudi Arabia, Texas, Panama and Chile. I have also had the opportunity to visit airline customers in Colombia, Costa Rica, Honduras, El Salvador, Mexico, Argentina and Peru. Having a strong technical background and second language skills really improved my ability to provide good customer service; the ability to understand cultural differences and adapt to the dif-



Luis Garcia enjoys being a cross-cultural ambassador for the airframer

ferent cultures is definitely needed in a customer-facing position like field service.

What are your current duties?

To ensure that my team provides superior support to our valued customers. We currently have five permanent members on our team. We provide first base training for new field representatives and host many Boeing visitors throughout the year. My responsibilities are to manage and mentor my team, deliver on customer expectations, build and maintain key customer relationships, and provide 24/7 technical support – including AOG, line and ramp, engineering, maintenance control, flight operations, material management, fleet management and special projects.

I led the 787 entry into service (EIS) team, which required close co-ordination between Boeing and our customers as they prepared for the introduction of the 787 to their fleet.

We provided enhanced support in the implementation of new technology into the airlines' infrastructure. I felt honoured to be a part of the 787 EIS programme – it was one of the most challenging and rewarding experiences in my aviation career – definitely a highlight.

What is your geographic range?

The Boeing field service office in Santiago, Chile, currently supports customers in Chile and Peru. When I was a field service representative in Panama, I supported all of Central America and

travelled to Costa Rica, Honduras and El Salvador as part of my support network.

What's the most difficult part of your job?

The most difficult part of the job is ensuring I have met all of our customers' expectations. It is not enough to simply give an answer. It is only by anticipating their needs, based on relationships and a true understanding of their operations, that we can develop the appropriate insight to truly provide great customer support.

Another aspect of the job is maintaining a sense of urgency when providing customer support. There have been many times when our team receives an urgent request late in the day or in the middle of the night and it is our job to provide an expedited response that will meet their urgent needs any time, day or night.

What do you enjoy about it?

I enjoy the opportunity to work with a customer that has a business culture that is different from what some might be accustomed to in the USA. I believe that the key to successful customer service is the building of relationships and trust. ■

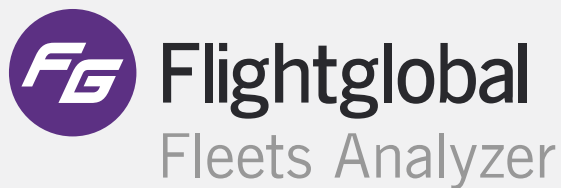


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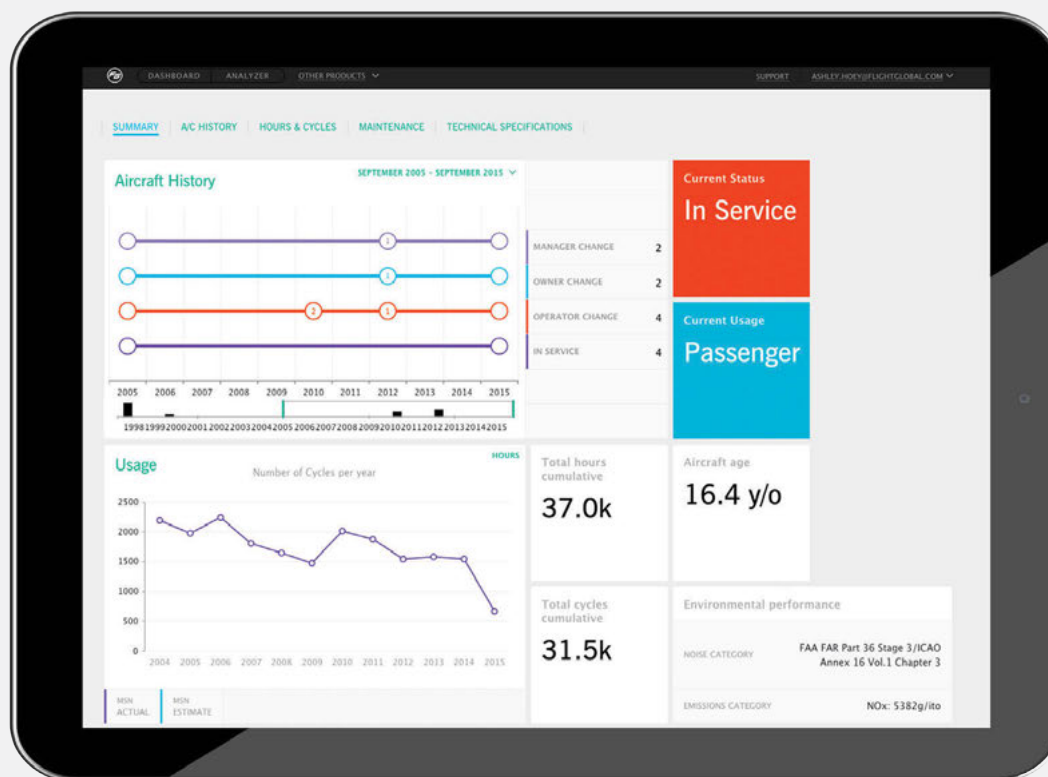


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